

**FLORIDA GEOLOGICAL SURVEY
TWELFTH ANNUAL REPORT**

212.4.

FLORIDA STATE GEOLOGICAL SURVEY

E. H. SELLARDS, STATE GEOLOGIST (*Resigned*)

HERMAN GUNTER, STATE GEOLOGIST

TWELFTH ANNUAL REPORT



PUBLISHED FOR
THE STATE GEOLOGICAL SURVEY
TALLAHASSEE, 1919.

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1919

LETTER OF TRANSMITTAL

To His Excellency, Hon. Sidney J. Catts, Governor of Florida:

SIR: In accordance with the law under which the State Geological Survey is established, I submit, herewith, my annual report. During the twelve years that it has been my privilege to serve as State Geologist of Florida, there has been published by this Department, including the present report, twelve volumes on the Geology and resources of the State, two bulletins on the special subjects of Water Supply and Public Roads, and nine shorter bulletins on various subjects; a total amounting to approximately 3,000 printed pages. In addition, there has been issued a general geological map of the State and several maps in moderate detail for various parts of the State. It has been the object in these reports and maps to present information of permanent value in the future development of the State, and although the edition of each report issued has necessarily been limited, the reports have found a place in public and other libraries to such an extent as to insure their being permanently accessible to those who are interested in the development of the resources of the State.

Permit me to express in this connection, my appreciation of the uniform courtesy that has been extended to me by you as Governor, and from your office. A similar acknowledgment is due the other Departments of the State with which this Department is more or less closely associated, as well as to the many citizens of the State who have taken an active interest in and have furthered the work of this Department. With the completion of this report I am presenting my resignation as State Geologist of Florida.

Very respectfully,

E. H. SELLARDS,
State Geologist.

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PUBLICATIONS ISSUED BY THE STATE GEOLOGICAL SURVEY.

The following is a list of the publications issued by the State Geological Survey since its organization :

- First Annual Report, 1908, 114 pp., 6 pls.
- Second Annual Report, 1909, 299 pp., 5 text figures and one map.
- Third Annual Report, 1910, 397 pp., 28 pls., 30 text figures.
- Fourth Annual Report, 1912, 175 pp., 16 pls., 15 text figures, one map.
- Fifth Annual Report, 1913, 306 pp., 14 pls., 17 text figures, two maps.
- Sixth Annual Report, 1914, 451 pp., 90 figures, one map.
- Seventh Annual Report, 1915, 342 pp., 80 figures, four maps.
- Eighth Annual Report, 1916, 168 pp., 31 pls., 14 text figures.
- Ninth Annual Report, 1917, 151 pp., 8 pls., 13 text figures, two maps.
- Tenth and Eleventh Annual Reports, 1918, 130 pp., 4 pls., 9 text figures, one map.
- Twelfth Annual Report (this volume), 1919.
- Bulletin No. 1. The Underground Water Supply of Central Florida, 1908, 103 pp., 6 pls., 6 text figures.
- Bulletin No. 2. Roads and Road Materials of Florida, 1911, 31 pp., 4 pls.
- Press Bull. No. 1. The Extinct Land Animals of Florida, February 6, 1913.
- Press Bull. No. 2. Production of Phosphate Rock in Florida during 1912, March 12, 1913.
- Press Bull. No. 3. Summary of Papers Presented by the State Geologist at the Atlanta Meeting of the American Association for the Advancement of Science, December 31, 1913.
- Press Bull. No. 4. The Utility of Well Records, January 15, 1914.
- Press Bull. No. 5. Production of Phosphate Rock in Florida during 1913, May 20, 1914.
- Press Bull. No. 6. The Value to Science of the Fossil Animal Remains Found Imbedded in the Earth, January, 1915.
- Press Bull. No. 7. Report on Clay Tests for Paving Brick, April, 1915.
- Press Bull. No. 8. The Phosphate Industry of Florida during 1917, May 2, 1918.
- Press Bull. No. 9. Survey of Mineral Resources, May 10, 1918.

DISTRIBUTION OF REPORTS

The reports issued by the State Geological Survey are distributed upon request, and may be obtained without cost by addressing the State Geologist, Tallahassee, Florida. Requests by those living outside of the State of Florida should be accompanied by postage or if desired the reports will be sent express collect.

TWELFTH ANNUAL ADMINISTRATIVE REPORT

EXPENDITURES OF THE GEOLOGICAL SURVEY FOR THE YEAR
ENDING DECEMBER 31, 1918.

The total appropriation for the State Geological Survey is \$7,500 per annum. No part of this fund is handled direct by the State Geologist, as all Survey accounts are paid upon warrants drawn upon the Treasurer by the Comptroller as per itemized statements approved by the Governor. The original of all bills and the itemized statements of all expense accounts are on file in the office of the Comptroller. Duplicate copies of the same are on file in the office of the State Geologist. The warrants when paid are on file in the office of the State Treasurer. A list of the warrants issued from January 1 to June 30, 1918, amounting to \$3,038.44, was given in the Eleventh Annual Report.

LIST OF WARRANTS ISSUED FROM JULY 1 TO DECEMBER 31, 1918

JULY, 1918.

Herman Gunter, assistant, salary for July, 1918 -----	\$ 150.00
Lila B. Robertson, services -----	35.00
Alex. Quarterman, services -----	9.00
Ed Lomas, janitor services -----	10.00
Maurice Joyce Engraving Company -----	98.45
Wrigley Engraving Company -----	7.50
T. J. Appleyard, printing -----	8.00
Sydney Prentice, drawings -----	20.00
H. & W. B. Drew Company, supplies -----	2.64
Southern Express Company -----	13.48

AUGUST, 1918.

E. H. Sellards, State Geologist, salary for July-August, 1918 -----	421.20
Herman Gunter, assistant, salary for August, 1918 -----	150.00
Lila B. Robertson, services -----	13.28
V. M. Nicholls, copying 1917 mineral production -----	7.71
Ed Lomas, janitor services -----	10.00
Seaboard Air Line Railway Company, freight -----	7.11
E. O. Painter Printing Company -----	499.16
American Railway Express Company -----	1.00

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SEPTEMBER, 1918.

Herman Gunter, assistant, salary for September, 1918 -----	150.00
Fred Collins, janitor services -----	10.00

OCTOBER, 1918.

Herman Gunter, assistant, salary for October, 1918 -----	150.00
Fred Collins, janitor services -----	10.00
A. N. Marquis & Company -----	5.50
American Railway Express Company -----	3.11

NOVEMBER, 1918.

Herman Gunter, assistant, salary for November, 1918 -----	150.00
Fred Collins, janitor services -----	10.00

DECEMBER, 1918.

Herman Gunter, assistant, salary for December, 1918 -----	150.00
Herman Gunter, assistant, expenses for December, 1918 -----	23.35
Fred Collins, janitor services -----	10.00
American Journal of Science, subscription -----	6.00
J. A. Cushman -----	400.00

Total expenditures from July 1 to December 31, 1918 -----	\$2,543.93
Total expenditures for year ending December 31, 1918 -----	\$5,582.37

LITERATURE RELATING TO HUMAN REMAINS AND ARTIFACTS AT VERO, FLORIDA

By E. H. SELLARDS.

In the July, 1916, issue of this journal the writer announced the discovery of human remains and artifacts in association with extinct vertebrates at Vero, Florida. Since that time there has accumulated a very considerable literature relating to the locality and to the discoveries. Among papers on this subject recently issued is a memoir by Dr. Ales Hrdlicka which is included in Bulletin 66 of the United States Bureau of American Ethnology (pp. 23-65, 1918).

In this memoir Dr. Hrdlicka maintains the hypothesis previously proposed by him that the human remains and artifacts found at Vero represent burials by human agency. Aside from adhering to this hopelessly inadequate hypothesis, the paper is remarkable for what it omits rather than for what it contains. Papers by a number of geologists and anthropologists had been published previous to the final revision of this memoir, as is indicated by a statement found on page 65 of the paper, but to the contents of these publications there is no adequate reference. The hypothesis proposed by Dr. R. T. Chamberlain, which is in accord neither with that of Dr. Hrdlicka nor with that of the present writer, receives not so much as mention. The investigations of Dr. O. P. Hay, which support the Pleistocene age of the human remains, is only casually referred to. The observations of Dr. G. G. MacCurdy, which in no way support the burial hypothesis are not mentioned. It might have been supposed that the observations and conclusions of a specialist in paleobotany would have been of interest, since an important part of the evidence in this instance rests with the fossil plants. Nevertheless the fact that Professor E. W. Berry has stated that he has personally observed artifacts in place in these deposits lying beneath a late Pleistocene flora under conditions such that they could not possibly have been introduced by human agency is singularly passed over. In fact the brief reference to

Berry's paper fails to indicate that in addition to a description of the fossil plants, he has placed on record observations relating to the place of the human relics in the deposits.

In the introductory paragraph of his "Critical Observations" Dr. Hrdlicka states that everything relating to human occupancy had been removed before anthropologists had an opportunity of visiting the locality. This is not in accordance with the facts, for, as everyone knows who has informed himself about the problem, the human artifacts have not all been removed, and anyone who is interested may yet see objects of human workmanship in place in this formation. Dr. Hrdlicka maintains that he has detected discrepancies in some of the writer's statements in regard to the measured thickness of parts of the section. Fortunately the problem does not rest on the writer's statements or observations alone, but on the observations of others as well. The student who is interested in the question of the age of the human remains found at this locality will do himself an injustice if he accepts this memoir by Dr. Hrdlicka as a fair presentation of the subject. Rather it will be necessary to consult the literature as a whole, and for the convenience of any who may be interested there are here included references to all the publications, so far as the writer is aware, that have appeared relating to the Vero deposits. The evidence both for and against the Pleistocene age of the human remains and artifacts has been fully stated in these papers. In the judgment of the writer it can not be successfully denied that at this locality there are found relics of human workmanship and human bones in association with and contemporaneous with a fauna and flora that elsewhere and heretofore have been considered Pleistocene.

BIBLIOGRAPHY

On the discovery of fossil human remains in Florida in association with extinct vertebrates, by E. H. Sellards, this Journal (*American Journal of Science*) Vol. 42, pp. 1-18, July, 1916.

Human remains from the Pleistocene of Florida, by E. H. Sellards, *Science*, N. S. Vol. 44, pp. 615-617, October 27, 1916.

Human remains and associated fossils from the Pleistocene of Florida, by E. H. Sellards, *Eighth Annual Report, Florida Geological Survey*, pp. 121-160, pls. 15-31; figs. 1-15, October, 1916.

On the association of human remains and extinct vertebrates at Vero, Florida, by E. H. Sellards, *Journal of Geology*, Vol. 25, pp. 4-24, January-February, 1917.

Interpretation of the formations containing human bones at Vero, Florida, by Rollin T. Chamberlin, *Journal of Geology*, Vol. 25, pp. 25-39, January-February, 1917.

On reported Pleistocene human remains at Vero, Florida, by Thomas Wayland Vaughan, *Journal of Geology*, Vol. 25, pp. 40-42, January-February, 1917.

Preliminary Report on Finds of Supposedly Ancient Human Remains at Vero, Florida, by Ales Hrdlicka, *Journal of Geology*, Vol. 25, pp. 43-51, January-February, 1917.

The Quaternary deposits at Vero, Florida, and the vertebrate remains contained therein, by Oliver P. Hay, *Journal of Geology*, Vol. 25, pp. 52-55, January-February, 1917.

Archæological evidences of man's antiquity at Vero, Florida, by George Grant MacCurdy, *Journal of Geology*, Vol. 25, pp. 56-62, January-February, 1917.

Further Notes on Human Remains from Vero, Florida, by E. H. Sellards. *Amer. Anthropologist*, N. S. pp. 239-251, Vol. 19, No. 2, April-June, 1917.

The problems of man's antiquity at Vero, Florida, by George Grant MacCurdy, *Amer. Anthropologist*, N. S. pp. 252-261, Vol. 19, No. 2, April-June, 1917.

On the finding of supposed Pleistocene human remains at Vero, Florida, by Oliver P. Hay, *Journal Washington Academy of Sciences*, Vol. 7, pp. 258-260, June 4, 1917.

Note on the deposits containing human remains and artifacts at Vero, Florida, by E. H. Sellards, *Journal of Geology*, Vol. 25, pp. 659-660, October-November, 1917.

The fossil plants from Vero, Florida, by Edward W. Berry, *Journal of Geology*, Vol. 25, pp. 661-666, October-November, 1917.

Further studies at Vero, Florida, by Rollin T. Chamberlin, *Journal of Geology*, Vol. 25, pp. 667-683, October-November, 1917.

A Review of some papers on fossil man at Vero, Florida, by Oliver P. Hay, *Science* (N. S.), Vol. 47, pp. 370-371, April 12, 1918.

Discussion and correspondence on the antiquity of man in America, by W. H. Holmes, *Science*, (N. S.) Vol. 47, pp. 561-562, June 7, 1918.

The Pleistocene man at Vero, Florida, by F. H. Sterns, *Scientific American Supplement*, No. 2214, pp. 354-355, June 8, 1918.

The Vero man and the sabre tooth, by G. R. Wieland, *Science*, N. S., Vol. 48, pp. 93-94, July 26, 1918.

Recent discoveries attributed to early man in America, by Ales Hrdlicka, *Bureau of American Ethnology*, Bulletin 66, 1918. Including a report on artifacts by Dr. W. H. Holmes.

Hay, O. P. Doctor Ales Hrdlicka and the Vero Man, *Science*, N. S., 48, pp. 462, 1918.

Review of the Ninth Annual Report of the Florida Geological Survey, *Science*, N. S., Vol. 47, pp. 394-395, 1918, by N. C. Nelson.

Chronology in Florida. *Anthropological Papers of the American Museum of Natural History*, Vol. 22, pt. 2, 1918, by N. C. Nelson.

The Pleistocene Man of Vero, Florida A Review of the latest evidence and theories. *Scientific American Supplement*, Feb. 22, 1919. By F. H. Sterns.

FOSSIL BEETLES FROM VERO, FLORIDA

By H. F. WICKHAM.*

In the interesting locality at Vero, Florida, now noted for the finds of human remains in association with those of Pleistocene mammals, several rather good specimens of insect fragments were found. All of the Coleopterous relics, most of them elytra, have been turned over to me by Dr. Sellards, for study, and form the basis of the following notes.

A specific account of the locality its geological history, stratification and fossils, will be found in an article by Dr. Sellards in the Eighth Annual Report of the Florida State Geological Survey, 1916, pp. 121-160. For the purpose of the present notes, it may be sufficient to say that the insects were found in both of the strata yielding human bones and implements, and in association with remains of the Columbian elephant, the American mastodon and other extinct mammals. The Coleoptera seem worth recording, partly because they throw some light on the probable climatic and ecological conditions at the time of their deposit, and partly because we may gather from them some ideas as to the relative rapidity of specific or subspecific change.

Two conclusions seem to be warranted after a study of the beetle fragments. The first is that there is nothing to indicate any particular difference in climatic conditions in Florida then and now, since the assemblage of genera is the same as one might expect to find in a stream valley there today. The nearest relatives of the species are still characteristic members of the Floridian fauna and many of them are apparently identical. Second, it seems evident that there has been some change in minor characters of sculpture, since it is not possible to match certain of the fossils exactly with modern forms. In view of the fact that other

*This paper on Fossil Beetles and the one which precedes relating to the literature on the locality at Vero were published in the May issue of the American Journal of Science, 1919.

researches indicate that insect evolution has been extremely slow, so that many species, even as old as the Tertiaries, are rather difficult to discriminate from their modern allies, no more marked divergence would be anticipated.

Besides a few small fragments that could not be determined, the following species are contained in the collections:

FAMILY CARABIDÆ

Diplochila laticollis Lec. Represented by a left elytron, complete except that the apex is slightly twisted and broken. In some lights the discal striæ are barely visibly punctate. There are no characters to differentiate this from a recent Iowa specimen. The species still occurs in Florida. Found in stratum 3.

Diplochila major Lec. Approximately the basal half of a right elytron is present. It shows no particular deviation from modern examples taken in Iowa, Indiana and Louisiana. Still occurs in Florida. Found in stratum 3.

Chlaenius aestivus Say. A right elytron is before me, lacking a small part of the scutellar region and all of the tip. Part of the pubescence is still preserved near the side. Compared with recent specimens from Lake City, Florida, the fossil is darker, perhaps from discoloration, and the interstitial punctuation is a little more scabrous or mucronate. It is still a rather abundant Florida insect. Found in stratum 3.

Chlaenius tricolor Dej. A left elytron, lacking the tip, seems to go here very well. An abundant insect in the eastern United States, including Florida. From stratum 3.

Chlaenius sp. A pronotum, simply labelled Vero, Florida, is different in some respects from any modern *Chlaenius* known to me. It may, however, belong to one of the southern species with which I am unacquainted.

Oodes amaroides Dej. An entire elytron, labelled like the preceding, is apparently just like a modern specimen from Indiana. It still occurs in Florida.

FAMILY SCARABÆIDÆ

Copris inemarginatus Blatchley. Represented by somewhat more than the basal half of a left elytron and a smaller curled fragment, taken from stratum 2, north bank, 370 feet west of the

bridge. Compared with a recent Iowa specimen of *Copris anaglypticus* Say, the fossil has narrower and sharper striae with deeper crenate punctures giving the sculpture a rougher appearance. The interstitial ridges in the fossil are barely visibly punctured (under a 9x lens) while in the Iowa example this punctuation is very distinct, though fine and sparse. However, in this latter feature the fossil is matched by a specimen of *C. inemarginatus* Blatchley, from Gainesville, Florida, kindly loaned me by Professor Watson, and the determination is made accordingly.

Strategus antaeus Fabr. From stratum 3 comes a left hind tibia which is shorter and relatively stouter than that of recent specimens from Florida and Massachusetts. The fossil is also darker, subopaque, the upper ridge more sinuate and the surface between this and the second ridge much more strongly and deeply punctuate. Since a recent individual from Georgia approaches the fossil closely in ridge structure and punctuation, I do not like to propose a new name.

University of Iowa, Iowa City.

ELEVATIONS IN FLORIDA.

HERMAN GUNTER

The following list of elevations in Florida is a revision of a list published in the Fifth Annual Report of the Florida Geological Survey, pages 81-101, 1913, by E. H. Sellards. The present list, however, is very much enlarged mainly by the addition of the results of spirit leveling in Florida by the United States Geological Survey and by the addition of elevations as determined by the various railroads since the former list was published.

The elevations from the railroad surveys are either taken direct from the profiles, or given as submitted to the Florida Geological Survey through the courtesy of the Chief Engineer of the different railroads, or as published in the 1913 list as taken from the Dictionary of Altitudes, Bulletin 274, United States Geological Survey. The precise levels which have been determined by the United States Geological Survey and by the United States Coast and Geodetic Survey were obtained from Bulletin 516 of the United States Geological Survey and through correspondence with the Superintendent of the United States Coast and Geodetic Survey, Washington, D. C. The levels made by the United States Army Engineers are obtained from Preliminary Survey for a Ship Canal from the St. Marys River to the Gulf of Mexico, made in 1879; Survey of the St. Johns River to Charlotte Harbor, by way of Lake Tohopekaliga, for purpose of steamboat communication, Appendix J, Annual Report of Chief of Engineers, 1882; Survey of the Kissimmee River, Florida, and connecting lakes and canals flowing into Lake Okeechobee, thence down the Caloosahatchee River to the Gulf of Mexico 1899; and two levels on the Apalachicola River from correspondence with the Superintendent of the United States Coast and Geodetic Survey. The levels by the State Drainage Commission are from a map of the Everglades district issued in 1913.

The abbreviations used in giving the authority for the elevations are as follows: U. S. G. S. (United States Geological Survey); U. S. C. & G. S. (United States Coast and Geodetic Sur-

vey); U. S. Army Engrs., (United States Army Engineers); Fla. State Engrs., (Engineers of the Florida State Drainage Commission); A. N. R. R. (Apalachicola Northern Railroad); A. & St. A. B. Ry. (Atlanta and St. Andrews Bay Railway); A. C. L. R. R. (Atlantic Coast Line Railroad); C. H. & N. Ry. (Charlotte Harbor and Northern Railway); F. E. C. Ry. (Florida East Coast Railway); G. F. & A. Ry. (Georgia, Florida and Alabama Railway); G. S. & F. Ry. (Georgia Southern and Florida Railway); L. & N. R. R. (Louisville and Nashville Railroad); M. & B. R. R. (Marianna and Blountstown Railroad); S. A. L. Ry. (Seaboard Air Line Railway); F. Ry. (Florida Railway); Fellsmere R. R. (Fellsmere Railroad). The elevation given for the towns, unless otherwise stated, is that of the depot of the railroad cited as authority.

Those elevations in the tabulated list preceded by an asterisk (*) are subject to minor corrections by the United States Coast and Geodetic Survey.

It is with due appreciation that acknowledgment is here made of the uniform courteous co-operation of the Engineering Departments of the several railroads operating in Florida. In supplying the Florida Geological Survey with blue prints of their profiles, and where blue prints could not be furnished in allowing access to the profiles and other records, and further in the giving of their time in supplying a list of elevations along their railway lines, all this has materially aided the Survey in its compilation work and added completeness to the list here published.

TOPOGRAPHIC MAPS.

No detailed topographic map of Florida has so far been issued. The United States Geological Survey has, however, published several topographic maps of quadrangles in certain portions of the State. Much of the recent mapping has been done in co-operation with the War Department, Corps of Engineers of the United States Army. The precise levels determined within several of the quadrangles were published in Bulletin 516 of the United States Geological Survey and are herewith republished as taken from that Bulletin. However, for many of the areas more re-

cently surveyed the precise levels, with a detailed description of the bench marks, are not yet available. Elevations taken from these sheets are given only to the nearest foot as shown on the map from which they were obtained, credit being made to the United States Geological Survey.

Maps of the following quadrangles, lying wholly or partly in Florida, have been surveyed up to January 1, 1919. For an index map showing the location of the published topographic sheets and for all information relative to the maps, application should be made to The Director, United States Geological Survey, Washington, D. C.:

Arredondo	Lawtey
Boulogne	Macclenny
Cambon	Mayport
Citra	Moniac
Dinner Island	Middleburg
Dunnellon	Ocala
Folkston	Orange Park
Green Cove Springs	Palatka
Hague	Palm Valley
Hawthorn	Panasoffkee
Hilliard	Starke
Interlachen	Tsala Apopka
Jacksonville	Welaka
Kingsland	Williston

LIST OF ELEVATIONS IN FLORIDA.

LOCALITY.	AUTHORITY.	Elevation Above Sea (feet)
Abbott -----	S. A. L. Ry.	110
Agnew -----	U. S. G. S.	70
Alachua,, S. A. L. depot -----	U. S. G. S.	60
Albion, S. A. L. depot -----	U. S. G. S.	81
Albion, in foundation of small new chimney on west side of frame building north of railroad station; bottom of a square cut in top of brick (C. & G. S. "Albion") -----	U. S. C. & G. S.	88.578
Allapaha River, Hamilton County, between mile posts 172 and 173 -----	G. S. & F. Ry. --	100
Alligator Creek, Hamilton County, between mile posts 176 and 177 -----	G. S. & F. Ry. --	98
Alligator Lake, Osceola County -----	U. S. Army Engrs., 1882---	71

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LOCALITY.	AUTHORITY.	Elevation Above Sea (feet).
Altamonte Springs -----	A. C. L. R. R.---	101
Altschule -----	G. F. & A. Ry.---	209.4
Andrews -----	U. S. G. S.-----	94
Ankona -----	F. E. C. Ry.----	33
Anthony -----	S. A. L. Ry.----	77
Apalachicola -----	A. N. R. R.-----	5
Apopka -----	S. A. L. Ry. ----	150
Apopka -----	A. C. L. R. R.---	125.2
Arcadia -----	A. C. L. R. R.---	56
Arch Creek -----	F. E. C. Ry.----	12.4
Arch Creek, Dade County, between mile posts 356 and 357 -----	F. E. C. Ry.----	10.0
Archer, 21 meters west and 9 meters south of station of Seaboard Air Line Railway, in line with tele- graph poles -----	U. S. C. & G. S.--	82.775
Archer, in brick chimney on south side of Mr. C. W. Banknight's house, a short distance north of track and opposite freight depot of Seaboard Air Line Ry., in ninth course above ground and in second brick from southwest corner of chimney, about one-fourth inch inside outer surface of brick; intersection of cross in end of copper bolt (C. & G. S. "Archer") -----	U. S. C. & G. S.--	85.070
Archer, about 3 miles west of, near fourth telegraph pole west of mile post 116, 9 meters north of Sea- board Air Line Railway tracks -----	U. S. C. & G. S.--	100.594
Archer, 3.2 miles northeast of, near mile post 110, in line with telegraph poles, 75 meters west of sign "Station one mile", 9 meters west of Seaboard Air Line Railway tracks -----	U. S. C. & G. S.--	84.186
Argyle -----	L. & N. R. R.---	254.8
Armour -----	A. C. L. R. R.---	70
Armstrong -----	F. E. C. Ry.----	38.0
Arnait -----	L. & N. R. R.---	252.3
Arran -----	G. F. & A. Ry.---	42.5
Arredondo, S. A. L. depot -----	U. S. G. S.-----	89
Arredondo, corner of orchard of D. G. Harvard, 0.9 meter from nearest corner post; bottom of a square cut in top of a piece of artificial stone 8 by 14 inches, buried with its upper surface 10 inches beneath surface of ground, and lettered "U. S. C. & G. S. B. M." (C. & G. S. "U") -----	U. S. C. & G. S.--	88.818
Ashmore -----	G. F. & A. Ry.---	47.5

ELEVATIONS IN FLORIDA.

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LOCALITY.	AUTHORITY.	Elevation Above Sea (feet).
Astor -----	A. C. L. R. R.---	15
Atlantic -----	S. A. L. R. R.---	125
Atlantic Beach -----	F. E. C. Ry.---	13.8
Auburndale -----	A. C. L. R. R.---	167
Aucilla -----	S. A. L. R. R.---	82.0
Aucilla River, west end of bridge -----	S. A. L. Ry.---	793
Aucilla, about ½ mile east of, at the first telegraph pole east of a cut; 26 feet south of Seaboard Air Line Railway tracks -----	U. S. C. & G. S.---	95.374
Aucilla, 244 feet west of the Seaboard Air Line Rail- way station, just outside the fence corner west of the first road west of the station. (U. S. G. S. Prim. Trav. Sta.) -----	U. S. C. & G. S.---	82.592
Aucilla, about 3 miles west of, at mile post 134; 26 feet north of Seaboard Air Line Railway tracks -----	U. S. C. & G. S.---	84.478
Aucilla, about 5 miles west of, at mile post 136; 26 feet north of Seaboard Air Line Railway tracks --	U. S. C. & G. S.---	88.589
Aurantia -----	F. E. C. Ry.---	28
Avoca -----	G. S. & F. Ry.---	120
Aycock -----	L. & N. R. R.---	128.3
Bakers Mill -----	A. C. L. R. R.---	137
Baldwin -----	A. C. L. R. R.---	83
Baldwin, 40 meters southwest of station, 12 meters north of south end of station shed, midway be- tween railway tracks, near a telegraph pole -----	U. S. C. & G. S.---	86.627
Baldwin, about 3½ miles west of, about ½ mile west of mile post "J22", 8 meters north of the Sea- board Air Line Railway tracks, in line with tele- graph poles. U. S. C. & G. S. -----	U. S. C. & G. S.---	78.809
Barberville -----	A. C. L. R. R.---	44
Barnett -----	A. C. L. R. R.---	135
Barth -----	L. & N. R. R.---	36.8
Bartow -----	A. C. L. R. R.---	115
Baxter -----	G. S. & F. Ry.---	120
Baxter -----	U. S. G. S.---	117
Bayard -----	F. E. C. Ry.---	25.5
Bayard, about 15 meters north of the station, 10 meters east of Florida East Coast Railway tracks --	U. S. C. & G. S.---	25.079
Bayard, about 3 miles south of, 1 meter from mile post "Jax 18" 10 meters west of Florida East Coast Railway tracks -----	U. S. C. & G. S.---	21.234
Baywood -----	G. S. & F. Ry.---	157
Bear Head -----	L. & N. R. R.---	268.8

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LOCALITY.	AUTHORITY.	Elevation Above Sea (feet).
Bellair -----	A. C. L. R. R.---	49
Bellevue -----	A. C. L. R. R.---	87
Benson -----	F. E. C. Ry.---	13.0
Beverly -----	A. N. R. R.---	10
Big Pine -----	F. E. C. Ry.---	8.1
Big Pottsburg Creek, Duval County, between mile posts 6 and 7 on the Mayport branch -----	F. E. C. Ry.---	18.4
Big Snake Creek, Dade County, between mile posts 353 and 354 -----	F. E. C. Ry.---	9.2
Biscayne -----	F. E. C. Ry.---	11.5
Bithlo -----	F. E. C. Ry.---	69.1
Black Creek -----	A. C. L. R. R.---	18
Black Point -----	F. E. C. Ry.---	11
Black Sink Prairie -----	U. S. G. S.---	60
Blake -----	F. E. C. Ry.---	12.6
Blanton -----	A. C. L. R. R.---	105
Blountstown Landing, end of railroad track -----	M. & B. R. R.---	51.1
Bluff Springs -----	L. & N. R. R.---	54.8
Boardman, A. C. L. depot -----	U. S. G. S.---	73
Bocaratone -----	F. E. C. Ry.---	17.9
Boden's -----	U. S. Army Engrs., 1903--	14
Bohemia -----	L. & N. R. R.---	43
Bonaventure -----	F. E. C. Ry.---	16.5
Bonifay -----	L. & N. R. R.---	120.8
Bostwick, 150 feet west of, southwest corner of station, in northwest corner of crossroads, at outer corner of fence; iron post stamped "34 Prim. Trav. Sta. No. 23" -----	U. S. C. & G. S.---	34.372
Bostwick, 1.3 miles west of, 50 feet southwest of road forks to northwest, about 600 feet east of old tram- way grade; nail in root of pine tree marked "52.5" -----	U. S. C. & G. S.---	52.49
Bostwick, 2.9 miles west of, about 0.2 miles west of creek, 15 feet southeast of culvert; nail in root of small cypress tree, marked "36.3" -----	U. S. C. & G. S.---	36.21
Bostwick, 3.4 miles west of, in southeast corner of crossroads, about 600 feet east of one bridge over Sims Creek, and about 400 feet north of another over same creek; iron post stamped "37 Prim. Trav. Sta. No. 22" -----	U. S. C. & G. S.---	36.706
Bostwick, 4.7 miles west of, at top of hill, 500 feet southwest of house, 10 feet north of road; nail in root of small black oak tree, marked "61.7" -----	U. S. C. & G. S.---	61.65

LOCALITY.	AUTHORITY.	Elevation Above Sea (feet).
Bostwick, 5.7 miles west of, in angle of road forks to northwest; nail in root of small red oak tree, marked "84" -----	U. S. C. & G. S.--	83.91
Bostwick, 6.2 miles west of, in northeast corner of crossroad, at east corner of Bannerville school house; iron post stamped "89 Prim. Trav. Sta. No. 21" -----	U. S. C. & G. S.--	89.234
Bostwick, 1.1 miles east of, 400 feet west of second-class road forks to south, 150 feet west of fence corner, 10 feet north of road; nail in root of large pine stump, marked "24.7" (unchecked elev.)	U. S. C. & G. S.--	24.70
Bostwick, 2 miles east of, 6 feet east of T road west, 100 feet east of creek crossing; iron post stamped "Prim. Trav. Sta. No. 24" (unchecked elev.) ----	U. S. C. & G. S.--	18.975
Bostwick, 7.2 miles west of, in southwest corner of crossroads, about 1,200 feet east of creek crossing; nail in root of red oak tree, marked "87.6" --	U. S. C. & G. S.--	87.55
Bostwick, 8.7 miles west of, 400 feet northeast of bridge over Sims Creek, 10 feet east of road; nail in root of large pine tree, marked "35.4" -----	U. S. C. & G. S.--	35.31
Boulogne -----	A. C. L. R. R.--	70
Boulogne -----	U. S. G. S.-----	59
Bowden, 300 meters north of mile post "Jax 5", 15 meters west of Florida East Coast Railway tracks, opposite cattle chute -----	U. S. C. & G. S.--	27.152
Bowes -----	L. & N. R. R.-----	128
Bowling Green -----	A. C. L. R. R.-----	116
Boynton -----	F. E. C. Ry.-----	14.5
Boynton, drainage canal north of -----	F. E. C. Ry.-----	13.5
Bradfordville, Leon County, maximum elevation on top of hill about $\frac{1}{2}$ mile north of, on Tallahassee-Thomasville public road -----	Fla. Road Dept.	238
Brandon -----	S. A. L. Ry.-----	74
Branford -----	A. C. L. R. R.-----	43
Braswell, 130 feet northeast of the Seaboard Air Line Railway depot, near telegraph pole, about 160 feet north of main track -----	U. S. C. & G. S.--	189.540
Brent -----	L. & N. R. R.-----	91.3
Bronson, 75 meters east of station, 10 meters south of Seaboard Air Line Railway track nearly opposite the city hotel, near east end of siding -----	U. S. C. & G. S.--	65.069
Bronson, south side of brick chimney at west end of Mrs. L. E. Taylor's house, north of track and nearly opposite railroad station, ninth course above		

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LOCALITY.	AUTHORITY.	Elevation Above Sea (feet).
ground, in second brick from southwest corner of chimney; intersection of cross in end of copper bolt: (C. & G. S. "W") -----	U. S. C. & G. S.	72.088
Bronson, Magnetic Station in the northwest corner of the school-house yard, about 70 meters northeast of the court house -----	U. S. C. & G. S.	77.382
Bronson, about three miles southwest of, near second telegraph pole southwest of mile post 125, near old saw mill; 10 meters north of Seaboard Air Line Railway tracks just south of a wagon road crossing track -----	U. S. C. & G. S.	54.580
Brooklyn -----	G. S. & F. Ry.	150
Brooksville -----	A. C. L. R. R.	126
Briggsville -----	F. E. C. Ry.	28.0
Bryceville -----	U. S. G. S.	69
Buena Vista -----	F. E. C. Ry.	14.6
Buena Vista, northeast corner of railroad station platform, at center of artificial stone post 8' by 8 inches in cross section and 3 feet long, projecting 6 inches above the surface; square cut in center marked "U. S." "B. M." (C. & G. S. "H") -----	U. S. C. & G. S.	14.722
Buffalo Bluff, railroad crossing; top of rail -----	U. S. C. & G. S.	15.8
Buffalo Bluff, 1,200 feet north of station, at end of switch, 10 feet west of railroad track, at northeast corner of base of signal tower; nut marked "15" -----	U. S. C. & G. S.	12
Bull Creek, Osceola County, between mile posts 78 and 79 on the Okeechobee division -----	F. E. C. Ry.	65.9
Bunnell -----	F. E. C. Ry.	23.4
Burnell -----	L. & N. R. R.	57.3
Burnett's Lake -----	S. A. L. Ry.	69
Bushnell -----	S. A. L. Ry.	75
Cadillac -----	A. C. L. R. R.	89
Caledonia -----	L. & N. R. R.	192
Callahan -----	A. C. L. R. R.	20
Callahan -----	U. S. G. S.	22
Calvenia -----	A. C. L. R. R.	45
Cambon -----	A. C. L. R. R.	63
Cambon -----	U. S. G. S.	59
Campbell -----	A. C. L. R. R.	75
Campton -----	L. & N. R. R.	172
Candler -----	A. C. L. R. R.	108
Cantonment -----	L. & N. R. R.	142.3
Capitola -----	A. C. L. R. R.	57

LOCALITY.	AUTHORITY.	Elevation Above Sea (feet).
Carleton -----	U. S. G. S.-----	145
Carraway -----	G. S. & F. Ry.---	78
Caryville -----	L. & N. R. R.---	57.8
Cashens -----	F. E. C. Ry.---	12.8
Causey -----	A. N. R. R.---	113
Cedar Keys, southwest corner of carpenter's shop at south end of D street; iron rod 6 feet long and 1 inch in diameter, with head 2 by 2 inches, driven in sand, with head a little below surface (C. & G. S. "Tidal") -----	U. S. C. & G. S.-	3.051
Cedar Keys, "Bench mark is the under edge of the sill of the front window at the southeast corner of the new concrete store, built in 1877 by Thomas Barnes"; lower edge of window sill (C. & G. S. "Perkins") -----	U. S. C. & G. S.-	11.717
Cedar Keys, north iron pier of Transit of Venus station, in surface of round pier 0.73 meter below top; intersection of cross cut in south face of iron pier marked "U. S. B. M." (C. & G. S. "Y")	U. S. C. & G. S.-	13.130
Cedar Keys, in south side of south iron pier used at Transit of Venus station, rectangular opening in side of pier 0.10 meter wide and 0.15 meter high; upper surface of bottom of square opening of iron pier marked "U. S. B. M." (C. & G. S. "Z")	U. S. C. & G. S.-	13.300
Cedar Keys, leaded in south face of brick transit pier of Transit of Venus station, sixth course above ground, in second brick from southwest corner of pier; intersection of cross in end of a copper bolt (C. & G. S. "Transit") -----	U. S. C. & G. S.-	12.749
Cedar Keys, about 4 miles east of, near third tele- graph pole east of mile post 152, 6 meters north of Seaboard Air Line Railway tracks -----	U. S. C. & G. S. -	8.688
Cedar Landing, water surface of Oklawaha River, March 15, 1911. -----	U. S. C. & G. S.-	10
Center Hill -----	A. C. L. R. R.---	91
Center Park -----	F. E. C. Ry.---	40.5
Center Park -----	U. S. G. S.---	41
Central Supply -----	F. E. C. Ry.---	11.3
Century -----	L. & N. R. R.---	75.3
Chaffin -----	L. & N. R. R.---	102
Chaires -----	S. A. L. Ry.---	56.8
Chaires, about 246 feet west of Seaboard Air Line Railway station, 50 feet south of main track -----	U. S. C. & G. S.-	58.215

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LOCALITY.	AUTHORITY.	Elevation Above Sea (feet).
Champaign, 2 meters east of mile post 115, 8 meters north of Seaboard Air Line Railway tracks	U. S. C. & G. S.	121.135
Chase	F. E. C. Ry.	10.2
Chatmar	A. C. L. R. R.	47.7
Chiefland	A. C. L. R. R.	39.9
Chipco	A. C. L. R. R.	104
Chipley	L. & N. R. R.	103.3
Chubb	A. C. L. R. R.	165
Chuluota	F. E. C. Ry.	63.9
Chumuckla	L. & N. R. R.	36.3
Citra	A. C. L. R. R.	61
Citronelle, A. C. L. depot	U. S. G. S.	26
City Point	F. E. C. Ry.	38.0
Clarcona	A. C. L. R. R.	81.3
Claroy	L. & N. R. R.	239.3
Clarksville, Duval County, about $\frac{3}{8}$ mile northwest of on F. E. C. Ry.	U. S. G. S.	22
*Clayno, northwest corner of house, 100 feet south- west of railroad crossing, 300 feet southeast of water tank; iron post stamped "155 Prim. Trav. Sta. No. 74"	U. S. C. & G. S.	153.517
*Clayno, 1 mile south of, 15 feet southwest of road forks to south; nail in root of large pine tree, marked "149.7"	U. S. C. & G. S.	148.19
*Clayno, 2.6 miles south of, 150 feet southeast of J. C. Padgett's mail box, 250 feet south of house, 25 feet south of road; nail in large pine tree	U. S. C. & G. S.	160.33
*Clayno, 3.4 miles south of, in east corner of road crossing, 300 feet north of large white house; iron post stamped "155 Prim. Trav. Sta. No. 75"	U. S. C. & G. S.	153.805
Clearwater	A. C. L. R. R.	29
Clermont	A. C. L. R. R.	105
Cleveland	A. C. L. R. R.	3
Cocoa	F. E. C. Ry.	26.5
Cocoanut Grove	F. E. C. Ry.	13.0
Colegrove	A. C. L. R. R.	125
Coline	A. N. R. R.	26
Collins	A. N. R. R.	158
Conant	A. C. L. R. R.	93
Cone	A. C. L. R. R.	125
Cook's Ferry	U. S. Army Engrs., 1903--	14
Coquina	F. E. C. Ry.	17
Cottdale	L. & N. R. R.	134.3

ELEVATIONS IN FLORIDA.

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LOCALITY.	AUTHORITY.	Elevation Above Sea (feet).
Cottendale -----	A. & ST. A. B. Ry. -----	134.3
Cowan -----	L. & N. R. R. -----	173
Cow Creek, Volusia County, between mile posts 5 and 6 on the Okeechobee division -----	F. E. C. Ry. -----	31.0
Cow Creek, Levy County -----	A. C. L. R. R. -----	30
Crane Creek, Brevard County, between mile posts 194 and 195 -----	F. E. C. Ry. -----	21.5
Crawford -----	G. S. & F. Ry. -----	85
Crawford -----	U. S. G. S. -----	84
Creighton -----	F. E. C. Ry. -----	39.6
Crestview -----	L. & N. R. R. -----	223.3
Criglar -----	A. N. R. R. -----	54
Crooked Lake, Polk County -----	U. S. Army Engrs., 1882 -----	132
Croom -----	A. C. L. R. R. -----	58
Cross Bayou -----	A. C. L. R. R. -----	10
Crown Point -----	A. C. L. R. R. -----	109
Crystal River, A. C. L. depot -----	U. S. G. S. -----	4
Cummer -----	A. C. L. R. R. -----	136
Cypress -----	L. & N. R. R. -----	136.3
*Cyril, 150 feet north of station, at railroad crossing; joint of west rail, marked "159.8" -----	U. S. C. & G. S. -----	158.3
*Cyril, 2 miles southwest of, 18 feet southwest of road, 10 feet south and southwest, respectively, of two pine trees painted "U. S. B. M.", in large white letters; iron post stamped "156 Prim Trav. Sta. No. 77" -----	U. S. C. & G. S. -----	154.912
*Cyril, 3.6 miles southeast of, 200 feet northeast of small swamp, 6 feet north of road; nail in root of pine tree located by primary traverse -----	U. S. C. & G. S. -----	151.79
Dade City -----	A. C. L. R. R. -----	89
Dade City -----	S. A. L. Ry. -----	106
Dahoma -----	U. S. G. S. -----	73
Dania -----	F. E. C. Ry. -----	12.0
Danzig -----	L. & N. R. R. -----	267.3
Daysville, 9 meters southwest of station and 9 meters west of Seaboard Air Line Railway track, near telegraph pole, 5 meters north of public highway -----	U. S. C. & G. S. -----	82.086
Daytona -----	F. E. C. Ry. -----	7.0
Deep Creek, St. Johns County, between mile posts 52 and 53 -----	F. E. C. Ry. -----	10.5
Deerfield -----	F. E. C. Ry. -----	15.6

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LOCALITY.	AUTHORITY.	Elevation Above Sea (feet).
Deerfield, Hillsboro canal north of -----	F. E. C. Ry.	12.4
Deerhunt -----	A. N. R. R.	82
Deerland -----	L. & N. R. R.	226.3
DeFuniak Springs -----	L. & N. R. R.	257.3
DeLand Junction -----	A. C. L. R. R.	27
Delespine -----	F. E. C. Ry.	33.0
Delph -----	A. C. L. R. R.	37
Delray -----	F. E. C. Ry.	20.3
Dinner Island, 55 feet north of switch point -----	F. E. C. Ry.	26.6
Dinsmore -----	A. C. L. R. R.	26
Dinsmore -----	U. S. G. S.	19
Doctors Inlet -----	U. S. G. S.	13
Drake -----	S. A. L. Ry.	135.7
Drifton -----	S. A. L. Ry.	130.1
Drifton, junction switch to Monticello -----	S. A. L. Ry.	129.3
Drifton, about opposite end of Seaboard Air Line Railway station, near telegraph pole, 26 feet south of track. (U. S. C. G. S. Prim. Trav. Sta.) -----	U. S. C. & G. S.	129.744
Drifton, about 9 miles west of, about 650 feet east of mile post 144, near road crossing, 26 feet south of Seaboard Air Line Railway track -----	U. S. C. & G. S.	148.687
Duke -----	A. C. L. R. R.	154
Dunedin -----	A. C. L. R. R.	13
Dunnellon, A. C. L. depot -----	U. S. G. S.	49
Dunns Creek, 1.5 miles west of, 25 feet southwest of road forks to southeast; nail in root of pine tree, marked "39.4" -----	U. S. C. & G. S.	39.62
Dupont -----	F. E. C. Ry.	27.0
Durbin -----	F. E. C. Ry.	61.2
Durbin, opposite the south end of the station shed, 10 meters east of Florida East Coast Railway tracks -----	U. S. C. & G. S.	60.043
Dutton -----	A. C. L. R. R.	71
Duval, about 3.5 miles south of, 0.3 miles south of rail- way bridge No. 10A, opposite mile post 10, and west of Seaboard Air Line Railway tracks -----	U. S. C. & G. S.	16.939
Duval, opposite switch stand at south end of switch, 0.5 mile south of mile post 14, 25 meters east of the Seaboard Air Line Railway -----	U. S. C. & G. S.	38.356
Dyal -----	A. C. L. R. R.	46
Dyal -----	U. S. G. S.	47
Eagle Island -----	U. S. Army Engrs., 1903.	63

LOCALITY.	AUTHORITY.	Elevation Above Sea (feet).
Early Bird -----	S. A. L. Ry.----	85
East Aurlantia -----	F. E. C. Ry.----	6
East Mandarin -----	U. S. G. S.----	23
East Mayport -----	F. E. C. Ry.----	10.0
East Mims -----	F. E. C. Ry.----	7.3
Eastport -----	U. S. G. S.----	16
East Palatka -----	F. E. C. Ry.----	17.7
East Palatka, front yard of residence of Mr. J. E. Gould, in top of an 8 by 8 by 18 inch marble post buried 16 inches in ground and lettered "U. S. B. M."; bottom of a square cut (C. & G. S. "T") --	U. S. C. & G. S.----	16.846
Eau Gallie -----	F. E. C. Ry.----	19.5
Econlochatchee River, Seminole County, between mile posts 32 and 33 on the Okeechobee division -----	F. E. C. Ry.----	26.9
Eddy, Gadsden County -----	A. N. R. R.----	200
Eddy, Baker County -----	G. S. & F. Ry.----	130
Eden -----	F. E. C. Ry.----	29.3
Ehren -----	A. C. L. R. R.----	90
Elbow Creek, Brevard County, between mile posts 190 and 191 -----	F. E. C. Ry.----	17.5
Eldred -----	F. E. C. Ry.----	31.9
Elkton -----	F. E. C. Ry.----	36.7
Ellaville -----	S. A. L. Ry.----	60.0
Ellaville, 20 meters south of Seaboard Air Line Rail- way station -----	U. S. C. & G. S.----	60.590
Ellaville, about 3 miles west of, at mile post 98, 8 meters north of Seaboard Air Line Railway tracks --	U. S. C. & G. S.----	84.764
Ellaville, about 6 miles west of, at mile post 101, 8 meters north of Seaboard Air Line Railway tracks --	U. S. C. & G. S.----	89.163
Ellerbee -----	U. S. G. S.----	148
Ellerslie -----	A. C. L. R. R.----	118
Ellzey, in northeast corner of front yard of house occupied by J. A. Williams, south of track and west of railroad station; bottom of a square cut in top of an artificial stone post 8x8x36 inches, buried 30 inches in the ground and lettered "U. S. C. & G. S. B. M." Post broken on top, Elevation slightly lower than original B. M. -----	U. S. C. & G. S.----	25.377
Ellzey, 14 meters west of station, 100 meters east of mile post 136, 9 meters north of Seaboard Air Line Railway track -----	U. S. C. & G. S.----	25.367
Enterprise -----	F. E. C. Ry.----	26
Enterprise -----	U. S. Army	

LOCALITY.	AUTHORITY.	Elevation Above Sea (feet).
Enterprise Junction -----	A. C. L. R. R.	26
Escambia -----	L. & N. R. R.	14
Espanola -----	F. E. C. Ry.	31.8
Eustis -----	A. C. L. R. R.	61
Eva -----	G. F. & A. Ry.	135
Everglade -----	F. E. C. Ry.	5.9
Everglades, near border of Lake Okeechobee -----	Fla., State Engrs.	21
Evinston, 450 feet north of station -----	U. S. G. S.	67
Fairbanks, 21 meters south of station, 9 meters west of Seaboard Air Line Railway track, in line with telegraph poles -----	U. S. C. & G. S.	162.319
Fairbanks, 10 feet southwest of southwest corner of Post Office; in southeast corner of inclosure, 450 feet north of station; iron post stamped "163 Prim. Trav. Sta. 55' -----	U. S. C. & G. S.	162.359
Fairbanks, about 3 miles northwest of, 150 feet south- west of east end of dead-head switch, in corner southwest of railroad crossing, near Milligan's still; iron post stamped '157 Prim. Trav. Sta. No. 56' --	U. S. C. & G. S.	156.935
Fair Grounds -----	L. & N. R. R.	129
Falco -----	L. & N. R. R.	235
Falmouth, about 20 meters north of the east end of the Seaboard Air Line Railway station -----	U. S. C. & G. S.	94.081
Favorita -----	F. E. C. Ry.	30.4
Federal Point -----	U. S. G. S.	6
Fellsmere -----	Fellsmere R. R.	27
Fellowship -----	U. S. G. S.	180
Fernandina -----	S. A. L. Ry.	10
Fernandina, about 3 miles south of, 3 meters west of mile post 3, 11 meters west of Seaboard Air Line Railway tracks, near sign "Draw bridge one mile" --	U. S. C. & G. S.	10.892
Fernandina, at the southeast corner, below the corner stone of the Post Office building on Center Street --	U. S. C. & G. S.	18.753
Fernandina, the intersection of a cross in end of a copper bolt leaded in the south face of the brick transit pier of the Transit of Venus Station. The bolt is in the sixth course above the ground and in the second brick from the S. W. corner of the pier. --	U. S. C. & G. S.	15.771
Fernandina, B. M. is top of a standard U. S. C. & G. S. cap B. M., screwed to an iron pipe 18 inches long. The lower end of the pipe was spread and the whole imbedded in a mass of concrete about three		

LOCALITY.	AUTHORITY.	Elevation Above Sea (feet).
feet in diameter at base and about seven inches at top. The cap is about flush with surface of ground and is located near southwest corner of Front and DeSoto Sts. It is about 25 feet south of center line of DeSoto St. and about 100 feet east of the waters edge. It is located between R.R. tracks, the nearest track to the west being 43 feet and the nearest to the eastward being 35 feet. It is 29 feet northerly from the center of the north side of an old frame-building formerly used as the office of the Chief Carpenter of the Seaboard Air Line Railway, and is 79.5 feet westerly from the N. W. corner of the freight house platform. B. M. 26 has a straight line cut within the circle at the center of the brass cap -----	U. S. C. & G. S.-	5.246
Fernandina, B. M. is a standard U. S. C. & G. S. brass cap B. M. secured in concrete in same manner as B. M. 26. It is located near north east corner of Front and DeSoto Streets. It is about 34 feet north of center line of DeSoto Street, and 11.5 feet west of south west corner of a frame building used as the office of the Jno. G. McGiffin & Co., Steamship Agents. The nearest rail of rail road tracks is 33 feet to the westward, and a fire hydrant at southeast corner of Front and DeSoto Streets, is 53 feet to the southward. The cap is about flush with the surface of the ground, and is marked by an X inside the circle at the center ----	U. S. C. & G. S.-	9.715
Fiftone, 10 meters east of track in line with old fence, on a high ridge about 50 meters south of wagon road crossing tracks, opposite old sawmill -----	U. S. C. & G. S.-	90.594
Flatford -----	A. C. L. R. R.-	57
Florahome -----	G. S. & F. Ry.-	128
Florahome, 0.2 mile east of, at railroad crossing; top of rail -----	U. S. C. & G. S.-	113
Florahome, 150 feet southeast of station, in southeast corner of T road south; iron post stamped "125 Prim. Trav. Sta. No. 26" -----	U. S. C. & G. S.-	124.518
Florahome, 0.8 mile west of, on southwest corner of railroad truss over creek; head of bolt marked "92.7" -----	U. S. C. & G. S.-	92.63
Floral City -----	A. C. L. R. R.-	57
Florence -----	G. F. & A. Ry.-	145.5
Florida-Alabama State Line, crossing of on the		

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LOCALITY.	AUTHORITY.	Elevation Above Sea (feet).
A. & St. A. B. Ry. -----	A. & ST. A. B.-----	156
Florida City -----	F. E. C. Ry.-----	9.8
Forest City -----	A. C. L. R. R.-----	92
Fort Drum -----	F. E. C. Ry.-----	58.9
Fort Gadsden -----	A. N. R. R.-----	20
Fort Lauderdale -----	F. E. C. Ry.-----	10.0
Fort Mason -----	A. C. L. R. R.-----	66
Fort Meade -----	A. C. L. R. R.-----	130
Fort Ogden -----	A. C. L. R. R.-----	37
Fort Pierce -----	F. E. C. Ry.-----	24.5
	U. S. Army	
Fort Vinton Island -----	Engrs., -----	26
Fort White -----	A. C. L. R. R.-----	63
Francis -----	A. C. L. R. R.-----	73
Francis, southwest corner of yard of small dwelling house belonging to R. D. Howell, north of track, facing railroad, second house west of railroad sta- tion, bottom of a square cut in top of an arti- ficial stone post 8 by 8 by 36 inches buried 30 inches in ground, lettered "U. S. C. &" "G. S. B. M." (C. & G. S. Francis) -----	U. S. C. & G. S.-----	69.397
Franklin -----	A. N. R. R.-----	8
Frely's Siding, about 3½ miles east of Greenville, 8 meters south of the Seaboard Air Line Railway tracks, 500 meters east of mile post 120 -----	U. S. C. & G. S.-----	114.974
Frontenac -----	F. E. C. Ry.-----	34.2
Fruita -----	F. E. C. Ry.-----	29.0
Fruitland Park -----	A. C. L. R. R.-----	113
Fulford -----	F. E. C. Ry.-----	10.3
Fullers -----	S. A. L. Ry.-----	200.8
Fulton -----	U. S. G. S.-----	4
Gabaroon -----	L. & N. R. R.-----	5.8
Gabriella -----	S. A. L. Ry.-----	80
Gainesville, crossing S. A. L. -----	A. C. L. R. R.-----	144
Gainesville -----	S. A. L. Ry.-----	147
Gainesville -----	A. C. L. R. R.-----	185
Gainesville, 24 meters from east end of station, between main track and switch track of Seaboard Air Line Railway, 25 meters northeast from main track -----	U. S. C. & G. S.-----	140.794
Gainesville, in the north face in the northeast corner of the Post Office building -----	U. S. C. & G. S.-----	173.871
Gainesville, in the east face near the northeast corner of the drug store building, southeast of the County Court House -----	U. S. C. & G. S.-----	179.232

LOCALITY.	AUTHORITY.	Elevation Above Sea (feet).
Gainesville, southwest corner of Court House yard; bottom of a square cut in top of an 8 by 8 by 26 inch marble post, buried 24 inches in ground and lettered "U. S. C. & G. S. B. M." (C. & G. S. "R") -----	U. S. C. & G. S.	176.992
Gainesville, west entrance to brick Court House, lowest step on right hand, near wall; bottom of a square cut in the upper surface of step, lettered "U. S. C. &" "G. S. B. M." (C. & G. S. "T") -----	U. S. C. & G. S.	178.727
Gainesville, middle of doorway leading to second story of brick Barnett Block facing Court House square, in middle of front of building; middle of raised, smooth band on outer edge of iron doorsill. (C. & G. S. "S") -----	U. S. C. & G. S.	177.210
Gainesville, one mile west of the County Court House, in the bottom step at the north entrance to the Engineering Building of the University of Florida -----	U. S. C. & G. S.	167.903
Gainesville, one mile west of the County Court House, in the step at the west entrance to the Engineering Building of the University of Florida -----	U. S. C. & G. S.	167.985
Gainesville, about 100 meters east of the north entrance to the Engineering Building of the University of Florida. B. M., is the top of the post marking the C. & G. S. Magnetic Station -----	U. S. C. & G. S.	166.722
Gainesville, about 150 meters northeast of the north entrance to the Engineering Building of the University of Florida. B. M. is the top of the stone post marking the meridian for the C. & G. S. Magnetic Station -----	U. S. C. & G. S.	168.061
Galliver -----	L. & N. R. R.	200.8
Galt City -----	L. & N. R. R.	66.8
Geneva -----	F. E. C. Ry.	73.3
Genoa -----	G. S. & F. Ry.	145
Georgia-Florida State Line, at crossing of on the Val- dosta-Palatka branch of the G. S. & F. Ry. between mile posts 168 and 169 -----	G. S. & F. Ry.	150
Georgia-Florida State Line, at crossing of on the Val- dosta-Jacksonville line of the G. S. & F. Ry., be- tween mile posts 208 and 209 -----	G. S. & F. Ry.	128
Getzens -----	S. A. L. Ry.	125
Gifford -----	F. E. C. Ry.	19.5
Glencoe -----	F. E. C. Ry.	26.8
Glen Ethel -----	A. C. L. R. R.	71
Glen St. Mary -----	S. A. L. Ry.	132.0

LOCALITY.	AUTHORITY.	Elevation Above Sea (feet).
Glen St. Mary, about 1 mile west of, near mile post C178, 8 meters north of Seaboard Air Line Rail- way tracks, in line with telegraph poles -----	U. S. C. & G. S.	127.969
Glen St. Mary, about 4 miles west of, near mile post C175, 8 meters north of Seaboard Air Line Rail- way tracks, in line with telegraph poles -----	U. S. C. & G. S.	133.960
Gomez -----	F. E. C. Ry.	26.6
Gomez Creek, Okeechobee County, near mile post 123 on the Okeechobee division -----	F. E. C. Ry.	57.2
Gonzalez -----	L. & N. R. R.	135.8
Good Range -----	L. & N. R. R.	164
Gordon -----	L. & N. R. R.	227
Gotha -----	A. C. L. R. R.	131.0
Goulding -----	L. & N. R. R.	82.3
Goulds -----	F. E. C. Ry.	12.3
Gradan -----	L. & N. R. R.	274.3
*Graham, 8 feet east of, southeast corner of station, at road crossing; top of west joining of railroad track, marked "144.4" -----	U. S. C. & G. S.	142.9
*Graham, 1.8 miles east of, 200 feet east of Graham- Starke and Graham-Hampton crossroads, opposite wide road entrance to house to south; iron post stamped "147 Prim Trav. Sta. No. 78" -----	U. S. C. & G. S.	145.209
*Graham, 3 miles east of, 50 feet northwest of second- class road to southwest, 6 feet north of road; nail in root of pine stump, marked "139.8" -----	U. S. C. & G. S.	138.32
*Graham, 4 miles east of, in west angle of road forks to northwest, about 400 feet northwest of house, 1 mile west of Hampton; nail in root of pine tree, marked "152.8" -----	U. S. C. & G. S.	151.28
Granada -----	A. C. L. R. R.	51
Grand Crossing -----	G. S. & F. Ry.	27
Grand Crossing -----	U. S. G. S.	25
Grandin -----	G. S. & F. Ry.	100
Grandin, 200 feet north of railroad station, at north- east corner of store, inside fence; iron post stamped "101 Prim. Trav. Sta. No. 27" -----	U. S. C. & G. S.	100.528
Grandin, 1.6 miles west of, at bottom of grade, near telephone pole, on south joint of rail; marked "97.8" -----	U. S. C. & G. S.	97.8
Grand Ridge -----	L. & N. R. R.	129.8
Grant -----	F. E. C. Ry.	11.0
Green Cove Springs -----	A. C. L. R. R.	28

LOCALITY.	AUTHORITY.	Elevation Above Sea (feet).
Greenland -----	F. E. C. Ry.-----	23.8
Greenland, about 30 meters south of the station, 10 meters west of the Florida East Coast Railway tracks, in line with telegraph poles -----	U. S. C. & G. S.-----	21.217
Greensboro -----	A. N. R. R.-----	280
Greens Crossing -----	L. & N. R. R.-----	223
Greenville -----	S. A. L. Ry.-----	102.9
Greenville, about 300 meters west of the Seaboard Air Line Railway station, 8 meters south of the Sea- board Air Line Railway main track and 8 meters east of the S. Ga. & W. C. Railway track near their crossing (U. S. G. S. Prim. Trav Sta.) ----	U. S. C. & G. S.-----	98.044
Greenville, S. Ga. & W. C. Railway crossing -----	S. A. L. Ry.-----	97.0
Greenville, in the south face of the brick building opposite the Seaboard Air Line Railway station --	U. S. C. & G. S.-----	99.376
Greenville, about $2\frac{1}{2}$ miles west of, near mile post 126; 26 feet north of Seaboard Air Line Railway tracks	U. S. C. & G. S.-----	93.015
Greenville, about $4\frac{1}{2}$ miles west of, in fence corner at road crossing; 586 feet east of mile post 128; 26 feet north of Seaboard Air Line Railway tracks. -----	U. S. C. & G. S.-----	91.424
Greenville, $1\frac{1}{2}$ miles east of, 100 meters east of mile post 122, near private road crossing, 8 meters south of Seaboard Air Line Railway tracks -----	U. S. C. & G. S.-----	100.941
Greenville, about $3\frac{1}{2}$ miles east of, at Frely's Siding, 8 meters south of Seaboard Air Line Railway tracks, 500 meters east of mile post 120 -----	U. S. C. & G. S.-----	114.974
Greenville, about $6\frac{1}{2}$ miles east of, 125 meters east of mile post 117, 8 meters south of Seaboard Air Line Railway tracks -----	U. S. C. & G. S.-----	100.899
Gretna -----	S. A. L. Ry.-----	290.4
Grove Park -----	A. C. L. R. R.-----	100
Grove Park, in northeast corner of, lot owned by M. S. Spray, across street south of railroad station; bot- tom of a square cut in artificial stone post 8 by 8 by 36 inches, buried 30 inches in ground and let- tered "U. S. C. & G. S. B. M." (C. & G. S. "P") --	U. S. C. & G. S.-----	100.542
Guilford -----	G. S. & F. Ry.-----	135
Gulf Hammock -----	A. C. L. R. R.-----	33
Gulf Junction -----	A. C. L. R. R.-----	67
Gull Point -----	L. & N. R. R.-----	11.3
Hague -----	A. C. L. R. R.-----	174
Haines City -----	A. C. L. R. R.-----	157

LOCALITY.	AUTHORITY.	Elevation Above Sea (feet).
Hainesworth -----	A. C. L. R. R.---	173
Hainesworth -----	S. A. L. Ry.---	142
Half Moon -----	A. C. L. R. R.---	54
Hallandale -----	F. E. C. Ry.---	11.0
Hammock Ridge, S. A. L. depot -----	U. S. G. S.---	78
Hampton -----	G. S. & F. Ry.---	148
Hampton, 150 feet east of northeast corner of station, 50 feet south of northwest corner of hotel, 8 feet north of pavement, 2 feet south of old con- crete well top, iron post stamped '150 Prim. Trav. Sta. No. 79' -----	U. S. C. & G. S.---	144.186
Hampton, 46 meters southwest of station, 40 meters south of white house, 20 meters west of Sea- board Air Line Railway track, in line with tele- graph poles -----	U. S. C. & G. S.---	148.057
Hampton, about 3 miles northeast of, 300 meters south of mile post 76 and irrigation ditch, 15 meters west of Seaboard Air Line Railway track, near fence line -----	U. S. C. & G. S.---	155.728
Hardaway -----	A. N. R. R.---	303
Hardee -----	A. C. L. R. R.---	38.2
Harold -----	L. & N. R. R.---	146.8
Harp -----	L. & N. R. R.---	25.8
Harwood -----	F. E. C. Ry.---	33.6
Haskell -----	A. C. L. R. R.---	116
Hastings -----	F. E. C. Ry.---	10.5
Hastings, in yard of Thomas H. Hastings' residence, near back steps of veranda, on west side of house; bottom of a square cut in top of marble post (Coast and Geodetic Survey bench mark) -----	U. S. C. & G. S.---	7.527
Hastings, about 300 feet south of station, in north- east corner of yard, west side of street; iron post stamped "9 Prim. Trav. Sta. No. 8" -----	U. S. C. & G. S.---	9.087
Hastings, 1.2 miles south of, in southeast angle of T road south, near schoolhouse, 30 feet east of road; nail in root of pine tree, marked "11.3" -----	U. S. C. & G. S.---	12.29
Hastings, 2.8 miles south of, 400 feet southwest of large white house, 10 feet west of road; nail in top of fence post, marked "18" -----	U. S. C. & G. S.---	19.11
Hastings, 3.4 miles south of, west side of road, oppo- site barn 200 feet east of road, 50 feet northwest of second-class road forks east; iron post stamped "17 Prim. Trav. Sta. No. 9" -----	U. S. C. & G. S.---	18.118

LOCALITY.	AUTHORITY.	Elevation Above Sea (feet).
Hastings, 4.5 miles south of, at corner of wire fence, 25 feet west of road; nail in root of pine tree, marked "20.7" -----	U. S. C. & G. S..	21.78
Hastings, 5.7 miles south of, 50 feet south of forks to southeast, 15 feet east of road; nail in root of pine tree, marked "24.6" -----	U. S. C. & G. S..	25.63
Hastings, 3.9 miles south of, 50 feet south of second- class road forks to southeast, 6 feet east of road; nail in root of pine tree, marked "23. 2" -----	U. S. C. & G. S..	23.32
Havana -----	G. F. & A. Ry..	243.2
Havana, about 325 feet west of the Georgia-Florida and Alabama Railway station; 6 feet north from north fence of a tobacco field, 49 feet south of the Georgia Florida and Alabama Railway main track -----	U. S. C. & G. S..	247.050
Havana, about 3.7 miles southeast of, at mile post 63; 33 feet north of Georgia Florida and Alabama Railway track -----	U. S. C. & G. S..	143.871
Hawks Park -----	F. E. C. Ry.----	13.2
Hawthorn, on south side (next railroad track) of frame dwelling house of W. T. Broswell, east of railroad station, in brick chimney, in eighteenth course above ground, second brick from south- west corner of chimney; intersection of cross in end of copper bolt (C. & G. S. "N") -----	U. S. C. & G. S..	145.150
Hawthorn, in brick chimney at north end of one-story house of J. N. Craig, north of railroad track, half a block from railroad station, in eighteenth course above ground and in corner brick at northeast corner of chimney; intersection of a cross in end of copper bolt (C. & G. S. "O") -----	U. S. C. & G. S..	146.840
Hayes -----	A. C. L. R. R.---	73
Heidtville -----	U. S. G. S.-----	61
Helen -----	G. F. & A. Ry.---	83.5
Hernando -----	A. C. L. R. R.---	50
Hibernia -----	U. S. G. S.-----	16
Highland -----	S. A. L. Ry.-----	210
Highland, about 1.5 miles south of, at mile post 63, 20 meters west of Seaboard Air Line Railway tracks -----	U. S. C. & G. S..	174.593
Highland, about 3 miles north of, about ½ mile south of mile post 59, about 110 meters north of bridge No. 59.6, 11 meters west of Seaboard Air Line Railway tracks, near abandoned road crossing -----	U. S. C. & G. S..	168.681
High Springs -----	A. C. L. R. R.---	75

LOCALITY.	AUTHORITY.	Elevation Above Sea (feet).
Hilliard -----	A. C. L. R. R.---	66
Hilliard -----	U. S. G. S.-----	70
Hilliardville -----	G. F. & A. Ry.---	63
Hillsboro -----	A. C. L. R. R.---	35
Hillsboro River, crossing S. A. L. Ry. -----	S. A. L. Ry.-----	45
Hinson -----	G. F. & A. Ry.---	252
Hobe Sound -----	F. E. C. Ry.-----	13.0
Hodges -----	S. A. L. Ry.-----	71
Hodges Mill, Putnam County, railroad crossing; top of rail -----	U. S. C. & G. S.---	12
Hogan -----	F. E. C. Ry.-----	24.0
Hogan -----	U. S. G. S.-----	23
Hollister, southwest corner of yard of dwelling house of Mr. T. W. Ralph, facing railroad, a short distance west of railroad station, north of track; bottom of a square cut in top of an artificial stone post 8 by 8 by 36 inches buried 30 inches in ground and lettered "U. S. C. &" "G. S. B. M." (C. & G. S. "K") -----	U. S. C. & G. S.---	80.268
Holly Hill -----	F. E. C. Ry.-----	6.9
Holopaw -----	F. E. C. Ry.-----	79.9
Holts -----	L. & N. R. R.---	193.3
Homeland -----	A. C. L. R. R.---	139
Homestead -----	F. E. C. Ry.-----	9.0
Homosassa, A. C. L. depot -----	U. S. G. S.-----	5
Hopkins -----	F. E. C. Ry.-----	19.7
Hosford -----	A. N. R. R.-----	88
Houston -----	S. A. L. Ry.-----	169.5
Houston, about 50 meters west of Seaboard Air Line Railway station, 8 meters south of tracks, in line with telegraph poles -----	U. S. C. & G. S.---	170.069
Hunter -----	U. S. G. S.-----	28
Huntington -----	A. C. L. R. R.---	56
Hurds -----	F. E. C. Ry.-----	44.4
Hypoluxo -----	F. E. C. Ry.-----	12.1
Indian River City -----	F. E. C. Ry.-----	19.0
Indian Springs -----	F. E. C. Ry.-----	41.5
Inglehome -----	U. S. G. S.-----	80
Inverness -----	A. C. L. R. R.---	38
Interlachen, on north side of a small triangular inclo- sure in front of Mr. James M. Erskine's feed store, opposite railroad station; bottom of a square cut in top of an artificial stone post 8 by 8 by 36 inches,		

LOCALITY.	AUTHORITY.	Elevation Above Sea (feet).
buried 30 inches in ground and lettered "U. S. C. & G. S. B. M. (C. & G. S. "L")	U. S. C. & G. S.	105.431
Inwood	L. & N. R. R.	160.3
Islamorada	F. E. C. Ry.	10.2
Island Grove	S. A. L. Ry.	69
Isabel Lake	U. S. Army Engrs., 1882	71
Island Lake	A. C. L. R. R.	54
Istachatta	A. C. L. R. R.	52
Jacksonville	A. C. L. R. R.	8
Jacksonville	G. S. & F. Ry.	15
Jacksonville, about 7 miles west of, 0.4 mile east of Marietta, seven telegraph poles west of mile post 7, 15 meters south of Seaboard Air Line Railway tracks	U. S. C. & G. S.	47.319
Jacksonville, about 4 miles west of, 3 meters north of mile post 4, 10 meters north of Seaboard Air Line Railway tracks	U. S. C. & G. S.	23.268
Jacksonville, in the south face near the southeast cor- ner of the Hotel Mason on Bay street	U. S. C. & G. S.	14.416
Jacksonville, in the west face of the west pillar at the north entrance to the S. B. Hubbard hardware store on Bay Street	U. S. C. & G. S.	9.580
Jacksonville, in the east face of the old County Court House, near the northeast corner	U. S. C. & G. S.	21.480
Jacksonville, in the west face near the entrance of the large brick building used as a bakery near Fifth and Main Street; 75 meters south of the Sea- board Air Line Railway crossing	U. S. C. & G. S.	25.367
Jacksonville, in the abutment at the south end of the Florida East Coast Railway bridge over the St. Johns River. Top of a 3 inch brass screw set in cement and marked 'B. M. Elev. 11.02'	U. S. C. & G. S.	11.115
Jamieson	G. F. & A. Ry.	140
Jamieson, at the west end of the Georgia Florida and Alabama Railway station platform, 6 feet south from the main track	U. S. C. & G. S.	146.981
Jasper	G. S. & F. Ry.	152
Jefferson	G. S. & F. Ry.	165
Jennings	G. S. & F. Ry.	150
Jensen	F. E. C. Ry.	23.5
Jewfish drawbridge on Long Creek Channel between mile posts 415 and 416	F. E. C. Ry.	10.0
Johnson	A. C. L. R. R.	100

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LOCALITY.	AUTHORITY.	Elevation Above Sea (feet).
Johnson -----	U. S. G. S. -----	102
Johnson Pond -----	U. S. G. S. -----	60
Julia, St. Johns County, about 1/2 mile east of -----	U. S. G. S. -----	31
Juliette, A. C. L. depot -----	U. S. G. S. -----	56
Juniper -----	A. N. R. R. -----	254
Jupiter -----	F. E. C. Ry. -----	12.9
Kanapaha, S. A. L. depot -----	U. S. G. S. -----	87
Kanapaha, at mile post 106, opposite old saw mill, 8 meters west of Seaboard Air Line Railway tracks	U. S. C. & G. S. -----	86.909
Kathleen -----	A. C. L. R. R. -----	133
Keens Mill -----	G. S. & F. Ry. -----	38
Kenansville -----	F. E. C. Ry. -----	75.9
Kendal -----	F. E. C. Ry. -----	13.0
Kendrick, A. C. L. depot -----	U. S. G. S. -----	82
Kenny -----	U. S. G. S. -----	131
Kent -----	G. S. & F. Ry. -----	70
Kent, about 1/2 mile east of on G. S. & F. Ry -----	U. S. G. S. -----	73
Kenwood -----	U. S. G. S. -----	44
Keuka -----	A. C. L. R. R. -----	101
Keuka -----	U. S. G. S. -----	101
Keystone Park -----	A. C. L. R. R. -----	32
Key West -----	F. E. C. Ry. -----	68
Killarney -----	A. C. L. R. R. -----	119
Kings Ferry -----	U. S. G. S. -----	20
Kingsford -----	A. C. L. R. R. -----	105
Kings Grove -----	G. S. & F. Ry. -----	21
*Kingsley Lake, north end of, at intersection of Law- tey-Green Cove Springs and Starke-Green Cove Springs roads, in west corner of forks, 150 feet south of deserted house; iron post stamped "211 Prim. Trav. Sta. No. 67" -----	U. S. C. & G. S. -----	210.867
*Kingsley Lake, 1.4 miles northwest of about 0.2 mile west of drain crossing, 6 feet north of road; nail in root of red oak tree -----	U. S. C. & G. S. -----	236.44
*Kingsley Lake, 2.6 miles northwest of, in south corner of tram and road crossing; iron post stamped "239 Prim. Trav. Sta. No. 68" -----	U. S. C. & G. S. -----	238.382
*Kingsley Lake, 3.8 miles west of, east angle of Starke Lumber Co., tramway forks to southeast, 30 feet east of Junction; nail in top of pine stump, marked "194" -----	U. S. C. & G. S. -----	193.51
*Kingsley Lake, 5.1 miles west of, 200 feet east of tramway crossing, in slight concave curve; nail in root of large pine tree -----	U. S. C. & G. S. -----	173.19

LOCALITY.	AUTHORITY.	Elevation Above Sea (feet).
Kissimmee	A. C. L. R. R.---	60.1
Kissimmee River at Bassenger Landing	U. S. Army Engrs., 1902---	35
Kissimmee River at Ft. Kissimmee Landing	U. S. Army Engrs., 1902---	51
Knights	S. A. L. Ry.---	117
Kolokee	F. E. C. Ry.---	32.3
Komoka	A. C. L. R. R.---	86
Korono	F. E. C. Ry.---	31.5
LaBuena	U. S. G. S.---	141
Lacoochee	A. C. L. R. R.---	72
LaCrosse	S. A. L. Ry.---	124
Lady Lake	A. C. L. R. R.---	77
Lagrange	U. S. Army Engrs., 1903---	26
Lake Buffum, Polk County	U. S. Army Engrs., 1882---	138
Lake Butler	G. S. & F. Ry.---	141
Lake Charm	S. A. L. Ry.---	60
Lake City	A. C. L. R. R.---	201
Lake City	G. S. & F. Ry.---	195
Lake City	S. A. L. Ry.---	196.5
Lake City	U. S. Army Engrs., 1879---	203
Lake City, in the brick wall just under the ticket office window	U. S. C. & G. S.---	198.471
Lake City, 50 meters east of Seaboard Air Line Rail- way station, 10 meters east of water tank, 8 meters south of Seaboard Air Line Railway tracks, near telegraph pole	U. S. C. & G. S.---	195.472
Lake City, about 1½ miles east of, crossing of Sea- board Air Line Railway	G. S. & F. Ry.---	190
Lake City, about 3 miles west of, at mile post 147 near west end of a small railway cut, 8 meters north of Seaboard Air Line Railway tracks	U. S. C. & G. S.---	140.279
Lake City, about 6 miles west of, at mile post 144, 8 meters north of Seaboard Air Line Railway tracks at Ogden Siding	U. S. C. & G. S.---	106.686
Lake City, about 9 miles west of, at mile post 141, 8 meters north of Seaboard Air Line Railway tracks	U. S. C. & G. S.---	149.813
Lake City Junction	A. C. L. R. R.---	51

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LOCALITY.	AUTHORITY.	Elevation Above Sea (feet).
Lake Clement -----	U. S. Army	
	Engrs., 1903---	9
Lake Geneva -----	G. S. & F. Ry.--	137
*Lake Geneva, 200 feet south of railroad station, at northeast corner of Baldwin and Kennedy's store; iron post stamped "130 Prim. Trav. Sta. No. 62" --	U. S. C. & G. S.--	130.065
*Lake Geneva, 1.2 miles north of, 15 feet west of road, 300 feet east of large sink hole; nail in root of dead pine tree, marked "158.6" -----	U. S. C. & G. S.--	158.59
*Lake Geneva, 2.2 miles north of, 140 feet northwest of road forks to southeast, about 700 feet east of lake; nail in root of pine tree, marked "132" ----	U. S. C. & G. S.--	132.06
*Lake Geneva, 3.2 miles north of, 50 feet west of road, 300 feet southwest of road forks. at top of rise; nail in root of pine snag, marked "149" -----	U. S. C. & G. S.--	148.93
*Lake Geneva, 3.8 miles north of, in southwest corner of road crossing, northeast of lake; iron post stamped "158 Prim. Trav. Sta. No. 63" -----	U. S. C. & G. S.--	157.627
*Lake Geneva. 4.5 miles north of, 10 feet northeast of road forks to southeast, 300 feet south of bridge over lake outlet, on sandhill; nail in root of black oak tree, marked "144.4" -----	U. S. C. & G. S.--	144.38
*Lake Geneva, 6.1 miles north of, 250 feet north of drain crossing, in northwest corner of intersection of Greencove-Theressa and Starke-Lake Geneva roads; iron post stamped "167 Prim. Trav. Sta. No. 64" -----	U. S. C. & G. S.--	167.427
*Lake Geneva, 7.9 miles north of, in southwest corner of forks of road to west, 500 feet west of lake; nail in root of red oak tree -----	U. S. C. & G. S.--	192.10
*Lake Geneva, 9.1 miles north of, 300 feet north of old mill stand, 13 feet north of old tram road; nail in root of blazed pine tree -----	U. S. C. & G. S.--	226.80
*Lake Geneva, 9.8 miles north of, in northeast corner of crossroads, 10 feet south of charred pine snag; iron post stamped "234 Prim. Trav. Sta. No. 65" --	U. S. C. & G. S.--	233.786
*Lake Geneva, 10.6 miles north of, in southeast corner of crossroads, 1 mile north of primary traverse station No. 65; nail in root of dead pine snag --	U. S. C. & G. S.--	238.66
*Lake Geneva, 12 miles north of, in northeast corner of crossroads; iron post stamped "246 Prim. Trav. Sta. No. 66" -----	U. S. C. & G. S.--	246.227

LOCALITY.	AUTHORITY.	Elevation Above Sea (feet).
*Lake Geneva, 13.5 miles north of, in southwest corner of crossroads, 250 feet southwest of deserted house, 6 feet west of road; nail in root of red oak tree -----	U. S. C. & G. S.	228.06
*Lake Geneva, 15.2 miles north of, west side of Kingsley Lake, northwest corner of crossroads; nail in root of red oak tree -----	U. S. C. & G. S.	215.04
Lake Harney, Orange County -----	U. S. Army Engrs., 1903---	5
Lake Helen -----	F. E. C. Ry.	63.5
Lake Helen Blazes -----	U. S. Army Engrs., 1903---	16
Lake Istokpoga -----	U. S. Army Engrs., 1902---	49
Lake Jackson -----	G. F. & A. Ry.	110
Lake Jessup, Orange County -----	U. S. Army Engrs., 1903---	4
Lake Kissimmee -----	U. S. Army Engrs., 1882---	59
Lake Lafayette, about 7 miles east of Tallahassee, at mile post 158; 26 feet north of Seaboard Air Line Railway tracks -----	U. S. C. & G. S.	49.009
Lakeland -----	A. C. L. R. R.	206
Lake Lenore -----	U. S. Army Engrs., 1882---	92
Lake Livingston, Polk County -----	U. S. Army Engrs., 1882---	91
Lake Lochloosa, water level of -----	S. A. L. Ry.	55
Lake Mary -----	A. C. L. R. R.	66
Lake Monroe, Volusia County -----	U. S. Army Engrs., 1903---	4
Lake Okeechobee -----	U. S. Army Engrs., 1902---	20
Lake Pickett -----	F. E. C. Ry.	71.2
Lake Poinsett, Brevard County -----	U. S. Army Engrs., 1903---	15
Lake View -----	F. E. C. Ry.	10.0
Lakeville -----	A. C. L. R. R.	84
Lake Tohopekaliga, Osceola County -----	U. S. Army Engrs., 1882---	64
Lake Washington, water surface, Brevard County --	U. S. Army Engrs., 1903---	16
Lake Winder, Brevard County -----	U. S. Army Engrs., 1882---	19

LOCALITY.	AUTHORITY.	Elevation Above Sea (feet).
Lake Winder, Brevard County -----	U. S. Army Engrs., 1903----	15
Lake Worth -----	F. E. C. Ry.----	19.0
Lane Park -----	A. C. L. R. R.----	61
Lantana -----	F. E. C. Ry.----	11.0
Largo -----	A. C. L. R. R.----	50
Larkin -----	F. E. C. Ry.----	13.0
Laurel Hill -----	L. & N. R. R.----	235
LaVilla Junction -----	A. C. L. R. R.----	19
Lawtey -----	S. A. L. Ry.----	140
Lawtey, 18 meters west of station and 18 meters east of Lawtey State Bank -----	U. S. C. & G. S.----	160.994
Lebanon -----	A. C. L. R. R.----	29.8
Ledwith Lake -----	U. S. G. S.----	66
Lee -----	S. A. L. Ry.----	92.4
Leesburg -----	A. C. L. R. R.----	85
Leesburg, crossing S. A. L. Ry. -----	A. C. L. R. R.----	76
Leesburg -----	S. A. L. Ry.----	72
Leitman -----	G. S. & F. Ry.----	149
Leitner, A. C. L. depot -----	U. S. G. S.----	73
Lemon Bluff -----	U. S. Army Engrs., 1903----	15
Lemon City -----	F. E. C. Ry.----	18.5
Lenard -----	A. C. L. R. R.----	115
Lennon, 36 meters east and 21 meters south of station, 19 meters south of Seaboard Air Line Railway track, 40 meters west of south end of siding -----	U. S. C. & G. S.----	43.727
Leroy, A. C. L. depot -----	U. S. G. S.----	85
Leroy Lake -----	U. S. G. S.----	63
Lexington -----	A. C. L. R. R.----	69
Liberty -----	A. N. R. R.----	94
Likely -----	F. E. C. Ry.----	17.0
Linden -----	A. C. L. R. R.----	90
Little Allapaha River, Hamilton County, between mile posts 178 and 179 -----	G. S. & F. Ry.----	97
Little Aucilla River -----	S. A. L. Ry.----	82.7
Little Lake Tohopekaliga -----	U. S. Army Engrs., 1882----	71
Little Pottsburg Creek, Duval County, between mile posts 3 and 4 on the Mayport division -----	F. E. C. Ry.----	14.5
Little River -----	F. E. C. Ry.----	10.0
Little River, Dade County, between mile posts 360 and 361 -----	F. E. C. Ry.----	9.0

LOCALITY.	AUTHORITY.	Elevation Above Sea (feet).
Little River, Gadsden County, between mile posts 182 and 183 -----	S. A. L. Ry.	86.6
Little Snake Creek, Dade County, between mile posts 354 and 355 -----	F. E. C. Ry.	9.0
Little Snake Creek, Monroe County, between mile posts 436 and 437 -----	F. E. C. Ry.	8.3
Little Wekiva River, Levy County -----	A. C. L. R. R.	28
Live Oak -----	S. A. L. Ry.	104.3
Live Oak, A. C. L. R. R. crossing -----	S. A. L. Ry.	103.9
Live Oak, L. O. P. & G. R. R. crossing -----	S. A. L. Ry.	106.4
Live Oak, about 2¾ miles east of, 50 meters east of mile post C130, 8 meters north of Seaboard Air Line Railway tracks -----	U. S. C. & G. S.	106.056
Live Oak, 70 meters east of Union Station one meter east of fence of a formal garden on railroad right of way, 10 meters north of Seaboard Air Line Railway main track -----	U. S. C. & G. S.	104.678
Live Oak, in the south face, beneath the ticket office window of the Union Passenger station -----	U. S. C. & G. S.	107.359
Live Oak, in the east face, near the northeast corner of the Suwannee County Court House -----	U. S. C. & G. S.	105.977
Live Oak, in the north face near the northeast corner of the U. S. Post Office Building -----	U. S. C. & G. S.	112.811
Live Oak, about 3½ miles west of, 25 meters east of mile post 85, 15 meters north of Seaboard Air Line Railway track, in fence corner on east side of hill -----	U. S. C. & G. S.	115.308
Live Oak, about 6.7 miles west of, at mile post 88, 15 meters north of Seaboard Air Line Railway track, in fence corner -----	U. S. C. & G. S.	96.637
Lloyd -----	S. A. L. Ry.	81.1
Lloyd, about 492 feet east of the Seaboard Air Line Railway station, 82 feet west of road crossing, 26 feet south of Seaboard Air Line Railway tracks --	U. S. C. & G. S.	80.325
Lloyd, opposite the Seaboard Air Line Railway station, 33 feet south of the main track -----	U. S. C. & G. S.	82.605
Lloyd, about 3 miles west of, at mile post 150, about 26 feet north of Seaboard Air Line Railway tracks -----	U. S. C. & G. S.	70.889
Lochapopka Lake -----	U. S. Army Engrs., 1882....	117
Lochloosa, S. A. L. depot -----	U. S. G. S.	60

LOCALITY.	AUTHORITY.	Elevation Above Sea (feet).
Lochloosa, 200 feet southeast of station, between main public road south and railroad; iron post stamped "Prim. Trav. Sta. No. 45, 65" -----	U. S. C. & G. S.	65.327
Lochloosa, 1 mile east of, 50 feet east of road forks to southwest, 15 feet south of road; nail in root of pine tree, marked "86" -----	U. S. C. & G. S.	86.12
Lochloosa, 2.1 miles east of, in southeast corner of crossroads; iron post stamped "82 Prim Trav. Sta. No. 46" -----	U. S. C. & G. S.	82.206
Lochloosa, 3.3 miles east of, 50 feet northeast of dim road southeast, 500 feet west of crossroads, 15 feet north of road; nail in root of pine tree, marked "87" -----	U. S. C. & G. S.	86.89
Lofton, about ½ mile west of, 100 meters west of mile post 8, and 12 meters south of Seaboard Air Line Railway tracks -----	U. S. C. & G. S.	34.121
Lokosee -----	F. E. C. Ry.	61.9
Long Bluff -----	U. S. Army Engrs., 1903---	19
Long Key -----	F. E. C. Ry.	11.5
Long Pine -----	L. & N. R. R.	107.3
Longwood -----	A. C. L. R. R.	80
Loretto -----	U. S. G. S.	23
Louisa, 50 feet southwest of station, about same distance west of crossing; iron post stamped "152 Prim. Trav. Sta. No. 76" -----	U. S. C. & G. S.	150.917
Lowell, A. C. L. depot -----	U. S. G. S.	95
Loxahatchee River, between mile posts 282 and 283 -----	F. E. C. Ry.	14.4
Lulu -----	G. S. & F. Ry.	152
Lyrata -----	F. E. C. Ry.	7.4
McAlpin -----	A. C. L. R. R.	103
McClenny -----	S. A. L. Ry.	130.4
McClenny, about 2½ miles east of, 650 meters west of mile post "J25", 8 meters north of Seaboard Air Line Railway tracks, in line with telegraph poles -----	U. S. C. & G. S.	153.094
McClenny, about 40 meters west of the station, 8 meters north of the Seaboard Air Line Railway tracks, in line with telegraph poles -----	U. S. C. & G. S.	131.581
McClenny, in the north bay, of the east end of the Baker County Court House -----	U. S. C. & G. S.	135.744
McDavid -----	L. & N. R. R.	36.8
McIntosh, A. C. L. depot -----	U. S. G. S.	73
McKinley -----	S. A. L. Ry.	122.9

LOCALITY.	AUTHORITY.	Elevation Above Sea (feet).
McMeekin, about 1 mile north of, in northeast corner of crossroads; nail in root of sapling, marked "139" -----	U. S. C. & G. S.	138.70
McMeekin, northeast corner of L. J. Stokes's store; artificial stone post (Coast and Geodetic Survey bench mark) -----	U. S. C. & G. S.	120.230
McMeekin, 3.1 miles south of, in south angle of forks to southwest; iron post stamped "117 Prim Trav. Sta. No. 32" -----	U. S. C. & G. S.	117.296
McMeekin, in inclosure just north of L. J. Stokes's store, 2 feet south of Coast and Geodetic Survey bench mark; iron post stamped "120 Prim. Trav. Sta." -----	U. S. C. & G. S.	120.364
McMeekin, at railroad crossing, top of rail -----	U. S. C. & G. S.	107
McMeekin, 1.3 miles southwest of, 30 feet southeast of second-class road forks to northwest; nail in root of water oak tree, marked "106" -----	U. S. C. & G. S.	105.98
McMeekin, 2.7 miles south of, in northeast corner of road crossing; nail in root of pine stump, marked "113.5" -----	U. S. C. & G. S.	113.47
McMeekin, 4.1 miles south of, 20 feet southeast of forks; nail in root of pine tree, marked "104.2" --	U. S. C. & G. S.	104.20
McMeekin, 5.4 miles south of, 25 feet southeast of road forks to northwest; nail in root of red oak tree, marked "99.8" -----	U. S. C. & G. S.	99.76
McMeekin, 6.1 miles south of, about 300 feet east of lake, in northeast corner of crossroads; iron post stamped "87 Prim Trav Sta. No. 33" -----	U. S. C. & G. S.	86.754
McMeekin, 7.1 miles south of, in northwest angle of T road west, about 200 feet west of creek and old mill; nail in root of red oak tree, marked "66.8" --	U. S. C. & G. S.	66.78
McMeekin, 7. 8. miles south of, 500 feet west of center of bridge over Orange Creek, 30 feet west of road forks: nail in root of red oak tree, marked "57.8" -----	U. S. C. & G. S.	57.72
McMeekin, 8.2 miles south of, about 1,800 feet southeast of Orange Creek, in triangle of T road east; iron post stamped "69 Prim Trav. Sta. No. 34" --	U. S. C. & G. S.	68.612
McMeekin, 9.8 miles south of, in southeast corner of crossroads, about 4 miles west of Orange Springs; nail in root of pine tree, marked "78.2" -----	U. S. C. & G. S.	78.10

LOCALITY.	AUTHORITY.	Elevation Above Sea (feet).
McMeekin, 10 miles south of, about 3 miles west of Orange Springs, 20 feet south of road forks to northwest, 200 feet north of small lake; nail in root of water oak, marked "75.4" -----	U. S. C. & G. S.	75.28
McMeekin, 11.5 miles southeast of, in northwest angle of road forks to northwest; nail in root of pine tree, marked "73" -----	U. S. C. & G. S.	72.75
McPherson -----	A. C. L. R. R.	184
McPherson -----	U. S. G. S.	184
Madison -----	S. A. L. Ry.	130.0
Madison, about 3 miles east of, 40 meters west of mile post 107, near private road crossing, 8 meters north of Seaboard Air Line Railway tracks ----	U. S. C. & G. S.	131.647
Madison, 400 meters east of Seaboard Air Line Rail- way station, 60 meters east of trestle which crosses track, in angle of a road, 30 meters north of the Seaboard Air Line Railway tracks -----	U. S. C. & G. S.	129.937
Madison, about 2 miles west of, 40 meters west of mile post 112, 8 meters north of Seaboard Air Line Railway tracks, near a road crossing -----	U. S. C. & G. S.	118.950
Magnolia Bluff -----	L. & N. R. R.	3.8
Magnolia Grove, about 5½ miles north of St. August- ine, 30 meters east of telephone booth, in line with telegraph poles -----	U. S. C. & G. S.	10.709
Maitland -----	A. C. L. R. R.	91
Malabar -----	F. E. C. Ry.	26.9
Mandarin -----	U. S. G. S.	16
Mandeville -----	U. S. G. S.	85
Manhattan Beach -----	F. E. C. Ry.	14.8
Manning -----	U. S. G. S.	133
Manning's Mill -----	L. & N. R. R.	207
Mannville -----	A. C. L. R. R.	89
Marathon -----	F. E. C. Ry.	7.5
Marianna -----	L. & N. R. R.	115.3
Marietta, 0.4 mile east of, seven telegraph poles west of mile post 7, 15 meters south of Seaboard Air Line Railway tracks -----	U. S. C. & G. S.	47.319
Marion -----	A. C. L. R. R.	159
Marshall's -----	U. S. Army Engrs., 1903	15
Martel, A. C. L. depot -----	U. S. G. S.	79
Martin, A. C. L. depot -----	U. S. G. S.	81
Mascotte -----	A. C. L. R. R.	115
Mattox -----	S. A. L. Ry.	84.0

LOCALITY.	AUTHORITY.	Elevation Above Sea (feet).
Mattox -----	U. S. G. S.-----	86
Maxville -----	S. A. L. Ry.-----	93
Maxville, about 2.3 miles south of, 0.3 miles south of mile post 56, 15 meters west of Seaboard Air Line Railway tracks, near road crossing -----	U. S. C. & G. S.-----	102.018
Maxville, about 1 mile north of, ½ mile south of mile post 52, opposite "station one mile" sign, 15 meters west of Seaboard Air Line Railway tracks -----	U. S. C. & G. S.-----	90.318
Mavis -----	L. & N. R. R.-----	269.7
Mayo -----	F. Ry.-----	69
Mayport -----	F. E. C. Ry.-----	8.8
Mayport -----	U. S. G. S.-----	6
Maytown -----	F. E. C. Ry.-----	34.8
Media -----	F. Ry.-----	68
Melbourne -----	F. E. C. Ry.-----	22.5
Melrose, southwest corner of town hall, 200 feet north of post office; iron post stamped "162 Prim Trav. Sta. No. 60" -----	U. S. C. & G. S.-----	162.223
Melrose, 0.3 mile east of post office, in southwest corner of cross-roads, near signboard "Starke 18 mi., McMeekin 9"; nail in root of pine tree, marked "153.7" -----	U. S. C. & G. S.-----	153.61
Melrose, 1.1 miles south of, 100 feet north of road northeast to house, 150 northeast of drain cross- ing, 8 feet east of road; nail in top of stump of twin tree, marked "115.3" -----	U. S. C. & G. S.-----	115.19
Melrose, 2.4 miles south of, in northwest corner of crossroads, near signboard "Interlachen 10 mi., Melrose 2½"; iron post stamped "122 Prim Trav. Sta. No. 30" -----	U. S. C. & G. S.-----	122.249
Melrose, 3.8 miles south of, 30 feet north of road forks northwest, near signboards pointing north and northwest, 15 feet east of road; nail in root of pine tree, marked "146" -----	U. S. C. & G. S.-----	145.93
Melrose, 5.9 miles south of, 100 feet northwest of crossroads, 10 feet northeast of corner of old schoolhouse; iron post stamped "179 Prim Trav. Sta. No. 31" -----	U. S. C. & G. S.-----	178.953
Melrose, 6.9 miles south of, 15 feet west of road forks to northeast, 8 feet west of road; nail in root of small black oak tree, marked "161.2" -----	U. S. C. & G. S.-----	161.07

LOCALITY.	AUTHORITY.	Elevation Above Sea (feet).
Melrose, 7.5 miles south of, about 1 mile north of McMeekin, in northeast corner of crossroads; nail in root of sapling, marked "139" -----	U. S. C. & G. S.	138.70
Melrose, 1.4 miles northeast of, in northeast angle of road forks to northeast, just behind large pine tree; nail in root of small water oak tree, marked "161.8" -----	U. S. C. & G. S.	161.71
Melrose, 2.2 miles northeast of, 30 feet west of road forks to southwest, about 250 feet south of drain crossing; iron post stamped "146 Prim. Trav. Sta. No. 61" -----	U. S. C. & G. S.	145.867
Melrose, 3.3 miles northeast of, at top of hill, 20 feet west of road, 2 feet southeast of 18-inch pine; nail in root of blazed oak tree, marked "144.5" ---	U. S. C. & G. S.	144.53
Meredith, 25 meters west of station, 10 meters north of Seaboard Air Line Railway tracks -----	U. S. C. & G. S.	92.992
Mexico -----	A. C. L. R. R.	50
Miami -----	F. E. C. Ry.	10.6
Miami River, Dade County, between mile post 366 and 367 -----	F. E. C. Ry.	10.0
Micanopy -----	A. C. L. R. R.	100
Micanopy Junction, in front of station, top of rail ----	U. S. C. & G. S.	72.4
Micanopy Junction, 0.4 mile south of, in southeast corner of railroad crossing, east of railroad track; iron post stamped "68 Prim. Trav. Sta. No. 42" --	U. S. C. & G. S.	68.424
Micanopy Junction, 1.3 miles southeast of, 15 feet north of road forks to southeast; nail in root of pine tree, marked "63" -----	U. S. C. & G. S.	62.73
Micanopy Junction, 2.4 miles southeast of, 25 feet south of road forks to northeast of house; nail in root of pine tree marked "73" -----	U. S. C. & G. S.	72.94
Micanopy Junction, 3.6 miles east of, in southeast corner of crossroads; iron post stamped "77 Prim. Trav. Sta. No. 43" -----	U. S. C. & G. S.	76.694
Micanopy Junction, 4.8 miles east of, in southwest corner of crossroads; nail in root of pine tree, marked "91" -----	U. S. C. & G. S.	90.74
Micanopy Junction, 5.8 miles east of, in east angle of road forks to south, about 600 feet southwest of house; nail in root of pine tree, marked "74" --	U. S. C. & G. S.	74.27
Micanopy Junction, 7.1 miles east of, about 300 feet east of bridge over Lochloosa Creek, in east angle of forks to north; iron post stamped "73 Prim Trav. Sta. No. 44" -----	U. S. C. & G. S.	72.900

LOCALITY.	AUTHORITY.	Elevation Above Sea (feet).
Micanopy Junction, 8.0 miles east of road forks, 200 feet west of drain crossing, 6 feet south of road; nail in root of pine tree, marked "66" -----	U. S. C. & G. S..	65.83
Micanopy Junction, 9.4 miles east of, 300 feet south of drain, 15 feet east of road; nail in root of pine tree, marked "76" -----	U. S. C. & G. S..	76.17
Micanopy Junction, 10.47 miles east, on Seaboard Air Line Railway; top of bolt on southeast corner of truss 103.5, marked "80" -----	U. S. C. & G. S..	80.02
Micco -----	F. E. C. Ry.----	25.5
Miccosukee -----	A. C. L. R. R.----	218
Middleburg -----	U. S. G. S.----	36
Middleton, southwest corner of front yard at residence of Philip Weedman, near fence, at center of marble post 8 by 8 inches in cross section and 3 feet long, projecting 6 inches above the surface and lettered "U. S." "B. M." square cut (C. & G. S. "F") -----	U. S. C. & G. S..	34.590
Midway -----	S. A. L. Ry.----	197.5
Midway, about 164 feet west of the Seaboard Air Line Railway station, 26 feet south of main track -----	U. S. C. & G. S..	196.758
Midway, about 4 miles west, about 325 feet west of mile post 181, 26 feet south of Seaboard Air Line Railway track, level with top of the rail, just east of a high railway embankment -----	U. S. C. & G. S..	122.395
Millard, S. A. L. depot -----	U. S. G. S.----	94
Millerton -----	S. A. L. Ry.----	89
Military Park -----	F. E. C. Ry.----	18.5
Mill Creek, Hamilton County, between mile posts 174 and 175 -----	G. S. & F. Ry.----	105
Milligan -----	L. & N. R. R.---	57.3
Millman -----	A. N. R. R.----	186
Milton -----	L. & N. R. R.---	4.3
Millwood, A. C. L. depot -----	U. S. G. S.----	86
Minneola -----	A. C. L. R. R.---	109
Minorville -----	A. C. L. R. R.---	122.0
Modello -----	F. E. C. Ry.----	11.2
Mohawk -----	A. C. L. R. R.---	130
Molino -----	L. & N. R. R.---	27.3
Moncrief Spring -----	A. C. L. R. R.---	14
Monroe -----	A. C. L. R. R.---	20
Monroe Creek, Gadsden County between mile posts 180 and 181 -----	S. A. L. Ry.----	102.7

LOCALITY.	AUTHORITY.	Elevation Above Sea (feet).
Montbrook -----	S. A. L. Ry.	82
Monticello -----	A. C. L. R. R.	202
Monticello, at Court House -----	Fla Geol. Surv.	237
Morriston -----	A. C. L. R. R.	68
Mosquito Creek, Gadsden County, between mile posts 206 and 207 -----	S. A. L. Ry.	80.3
Mosquito Creek, Gadsden County, between mile posts 207 and 208 -----	S. A. L. Ry.	77.2
Mossy Head -----	L. & N. R. R.	256.8
Mount Carrie -----	S. A. L. Ry.	197
Mount Pleasant -----	S. A. L. Ry.	297.7
Mount Pleasant, 97 feet southwest of the Seaboard Air Line Railway station, 26 feet south of rail- road track nearly opposite the U. S. mail stand --	U. S. C. & G. S.	296.049
Mount Pleasant, about 3 miles west of, 130 feet west of mile post 201, 26 meters south of Seaboard Air Line Railway tracks -----	U. S. C. & G. S.	185.800
Mouth of Bow Legs Creek -----	U. S. Army Engrs., 1882.	73
Mouth of Cow Creek -----	U. S. Army Engrs., 1882.	20
Mulat -----	L. & N. R. R.	3.8
Mule Creek, Levy County -----	A. C. L. R. R.	29
Mullet Lake -----	U. S. Army Engrs., 1903.	5
Mulberry Mound -----	U. S. Army Engrs., 1903.	26
Naranja -----	F. E. C. Ry.	12.0
Narcoossee -----	A. C. L. R. R.	72
Nashua, 600 feet north of post office, in southwest corner of road forks, 150 feet southeast of school- house, near signboard "Satsuma 2½ mi., Sisco 2 mi.," nail in root of pine tree, marked "87.8" ----	U. S. C. & G. S.	87.99
Neoga -----	F. E. C. Ry.	40.0
Newberry -----	A. C. L. R. R.	72
New Berlin -----	U. S. G. S.	9
New River -----	G. S. & F. Ry.	143
New River, Bradford County, 200 feet south of, south- east corner of railroad station, 300 feet east of store and 75 feet northwest of northwest corner of cotton gin; iron post stamped "146 Prim. Trav. Sta. No. 73" -----	U. S. C. & G. S.	144.813

LOCALITY.	AUTHORITY.	Elevation Above Sea (feet).
New River, Bradford County, 1 mile south of, in northeast angle of road forks to east; nail in root of large pine tree, marked "155.5" -----	U. S. C. & G. S.	153.93
New River, Bradford County, 1.6 miles south of, on main Starke road, 50 feet northeast of culvert, 15 feet north of road; nail in root of large pine tree, marked "157" -----	U. S. C. & G. S.	155.41
New River, Bradford County, 2.6 miles south of, in northwest corner of crossing of old tramway and road; nail in root of pine tree, marked "157.3" --	U. S. C. & G. S.	155.76
New River drainage canal, Broward County -----	F. E. C. Ry.	9.0
New Smyrna -----	F. E. C. Ry.	10.3
Ninety-Five, 3.6 miles northeast of Gainesville. About 75 meters north of mile post 95, 25 meters west of track in line with telegraph poles and opposite old still near railroad crossing -----	U. S. C. & G. S.	161.33 ²
Nittaw -----	F. E. C. Ry.	63.9
Nocatee -----	A. C. L. R. R.	38
North Escambia -----	L. & N. R. R.	2.8
Oak Hill -----	F. E. C. Ry.	18.7
Oakland -----	A. C. L. R. R.	119
OakLawn, A. C. L. depot -----	U. S. G. S.	79
O'Brien -----	A. C. L. R. R.	58
Ocala, A. C. L. depot* -----	U. S. G. S.	99
Ocala, S. A. L. depot -----	U. S. G. S.	68
Ocklawaha -----	A. C. L. R. R.	66
Ocklocknee River, east end of bridge, Leon County --	S. A. L. Ry.	87.0
Odessa -----	A. C. L. R. R.	57
Ocoee -----	A. C. L. R. R.	119.0
Ogden -----	U. S. C. & G. S.	111.2
Ogden, about 6 miles west of Lake City, at mile post 144, 8 meters north of Seaboard Air Line Rail- way tracks -----	S. A. L. Ry.	106.686
Ojus -----	F. E. C. Ry.	7.2
Okahumpka -----	A. C. L. R. R.	95
Okeechobee -----	F. E. C. Ry.	33.3
Okeechobee Lake -----	U. S. Army Engrs., 1882	20
Olive -----	L. & N. R. R.	131.8
Olustee, -----	S. A. L. Ry.	161.6
Olustee, 12 meters east of Seaboard Air Line Railway station, 8 meters north of tracks, near mile post		

*Ocala, at the present time has a union depot. The elevations refer to the old depots.

LOCALITY.	AUTHORITY.	Elevation Above Sea (feet).
C162 -----	U. S. C. & G. S.	174.002
Olustee, about 3 miles west of, near mile post C159, 8 meters north of the Seaboard Air Line Railway tracks -----	U. S. C. & G. S.	172.808
Olustee, about 6 miles west of, near mile post C156, 8 meters north of Seaboard Air Line Railway tracks -----	U. S. C. & G. S.	179.311
Olustee Creek, Bradford County, between mile posts 223 and 224 -----	G. S. & F. Ry.	122
O'Neill, on range with telephone poles, 5 meters west of southwest corner of station -----	U. S. C. & G. S.	134.12
Orange Center -----	A. C. L. R. R.	102.0
Orange City -----	F. E. C. Ry.	35.8
Orange City Junction -----	F. E. C. Ry.	39.2
Orangedale, St. Johns County -----	U. S. G. S.	30
Orange Heights -----	S. A. L. Ry.	130
Orange Lake, A. C. L. depot -----	U. S. G. S.	88
Orange Lake, water level of -----	S. A. L. Ry.	54
Orange Mills -----	F. E. C. Ry.	16.0
Orange Mills -----	U. S. G. S.	15
Orange Mills, about ½ mile northeast of on the Florida East Coast Railway -----	U. S. G. S.	15
Orange Park -----	A. C. L. R. R.	23
Orange Park -----	U. S. G. S.	17
Orange Springs, 200 feet east of post office, in in- closure, northwest corner of road crossing; iron post stamped "63 Prim Trav. Sta. No. 35" -----	U. S. C. & G. S.	62.572
Orange Springs, 1.1 miles east of, in northwest corner of crossroads; nail in root of pine tree, marked "66.7" -----	U. S. C. & G. S.	66.60
Orange Springs, water surface of Oklawaha River, March 13, 1911 -----	U. S. C. & G. S.	13
Orange Springs, 2.8 miles east of, at top of hill, in east corner of forks to south; nail in root of tree, marked "68.6" -----	U. S. C. & G. S.	68.44
Orange Springs, 3.4 miles east of, in southwest corner of crossroads; iron post stamped "135 Prim. Trav. Sta. No. 36" -----	U. S. C. & G. S.	134.426
Orange Springs, 5.1 miles east of, on top of rise, 150 feet east of forks to southwest, 200 feet south of old house, 6 feet south of road; nail in root of red oak tree, marked "132.5" -----	U. S. C. & G. S.	132.38

LOCALITY.	AUTHORITY.	Elevation Above Sea (feet).
Orange Springs, 6.1 miles east of, about 0.2 mile north of Cedar Landing, 50 feet southwest of forks, 6 feet west of road; nail in root of water oak tree, marked "14.3" -----	U. S. C. & G. S.	14.12
Orange Springs, 7.4 miles east of, in northwest corner of dim crossroads, about 1.5 miles northeast of Cedar Landing; nail in root of pine tree, marked "25.2" -----	U. S. C. & G. S.	27.03
Orange Springs, 8.2 miles east of, 30 feet north of tramway crossing, at southwest corner of shack; iron post stamped "26 Prim Trav Sta. No. 37" --	U. S. C. & G. S.	25.469
Orange Springs, 9.9 miles east of, south side of road, opposite T road north, 20 feet north of old schoolhouse; nail in top of pine stump, marked "48.8" -----	U. S. C. & G. S.	48.62
Orange Springs, 11.1 miles east of, 200 feet northeast of forks to west, 20 feet west of road, 400 feet northwest of low place in road; nail in root of pine tree, marked "28.8" -----	U. S. C. & G. S.	28.56
Orlando -----	A. C. L. R. R.	111
Ormond -----	F. E. C. Ry.	6.6
Osceola -----	S. A. L. Ry.	50
Oslo -----	F. E. C. Ry.	16.5
Osteen -----	F. E. C. Ry.	48
Otter Creek -----	A. C. L. R. R.	27.4
Otter Creek, S. A. L. depot -----	U. S. G. S.	29
Otter Creek, in south side of brick chimney in east end of two-story frame house, eighteen courses above ground, in second brick from southeast corner of chimney; intersection of cross in end of copper bolt (C. & G. S. "Otter Creek") -----	U. S. C. & G. S.	32.384
Otter Creek, about 2.5 miles northeast of, near mile post 132, 10 meters north of Seaboard Air Line Railway tracks 0.4 mile west of water tank -----	U. S. C. & G. S.	28.720
Owensboro -----	A. C. L. R. R.	76
Oxton -----	L. & N. R. R.	110.3
Ozona -----	A. C. L. R. R.	5
Pablo Beach -----	F. E. C. Ry.	10.3
Pablo Creek, Duval County, between mile posts 15 and 16 on the Mayport branch -----	F. E. C. Ry.	15.3
Pace Junction -----	L. & N. R. R.	13.8
Padlock -----	A. C. L. R. R.	124
Palatka -----	G. S. & F. Ry.	7

LOCALITY.	AUTHORITY.	Elevation Above Sea (feet).
Palatka, at southeast corner of train shed of Union Station, on corner of concrete curb; chiseled square marked "23.6" -----	U. S. C. & G. S.	23.87
Palatka, in southwest corner of courthouse square; iron post stamped "19 Prim. Trav. Sta. No. 7" --	U. S. C. & G. S.	19.390
Palatka, 1 mile north of, 300 feet south of mile post, 8 feet west of railroad track, northeast corner of base of signal tower; bolt marked "18.3" -----	U. S. C. & G. S.	18.31
Palatka, near south side of north door on west side of Atlantic Coast Line Railroad offices, in two-story brick building near St. Johns River, at west end of bridge over river; bottom of a square cut in granite doorsill lettered "U. S." "B. M." (C. & G. S. "J") -----	U. S. C. & G. S.	12.706
Palmer, near old C. & G. S. bench mark (destroyed), on high ground about 30 meters northeast of Seaboard Air Line Railway station, top of iron pipe in concrete in tin stove pipe. Cement is marked 74.684 -----	U. S. C. & G. S.	75.351
Palmer, top of foundation, at northwest corner, 2 feet above ground, at west end of small house north of track and a little west of railroad station; bottom of a square cut in top of one of the stones forming foundation of brick chimney, lettered "U. S. B. M." (C. & G. S. "V") -----	U. S. C. & G. S.	76.348
Palm Springs -----	A. C. L. R. R.	61
Palm Valley, St. Johns County -----	U. S. G. S.	8
Panama Park, 20 meters east of Seaboard Air Line Railway tracks, opposite the station -----	U. S. C. & G. S.	17.247
Panasoffkee -----	S. A. L. Ry.	58
Panasoffkee Lake -----	U. S. G. S.	40
Paola -----	A. C. L. R. R.	79
Paradise -----	A. C. L. R. R.	192
Park Place, A. C. L. depot -----	U. S. G. S.	6
Pasco -----	A. C. L. R. R.	110
Paynes Prairie, water level in sink at low stage ----	U. S. G. S.	58
Peace Creek, at mouth of Big Charley Apopka -----	U. S. Army Engrs., 1882	17
Pebble -----	A. C. L. R. R.	136
Penial, 1,600 feet west of station, on northwest abutment of bridge over drain, 2 feet below level of railroad track; top of bolt marked "24" -----	U. S. C. & G. S.	24.34
Penial, railroad crossing at station; top of rail ----	U. S. C. & G. S.	25
Pensacola -----	L. & N. R. R.	21.3

LOCALITY.	AUTHORITY.	Elevation Above Sea (feet).
Peoria -----	U. S. G. S.	28
Perkins Crossing -----	L. & N. R. R.	242
Perrine -----	F. E. C. Ry.	13
Perry -----	F. Ry.	30
Persimmon Bluff -----	U. S. Amry Engrs., 1903.	17
Peters -----	F. E. C. Ry.	13.0
Phosphoria Junction -----	A. C. L. R. R.	123
Pickett -----	U. S. G. S.	28
Pierson -----	A. C. L. R. R.	78
Pine Barren -----	L. & N. R. R.	21.8
Pine Crest -----	A. C. L. R. R.	82
Pine Island -----	S. A. L. Ry.	119
Pine Orchard -----	L. & N. R. R.	165
Pineway -----	L. & N. R. R.	223
Piney Grove -----	L. & N. R. R.	78.8
Pin Hook -----	S. A. L. Ry.	188.3
Plantation -----	F. E. C. Ry.	9.3
Plant City -----	A. C. L. R. R.	137
Plant City -----	S. A. L. Ry.	125
Plummer -----	G. S. & F. Ry.	21
Plummer -----	U. S. G. S.	19
Pocataw -----	F. E. C. Ry.	70.5
Pomona, 300 feet north of station, in southwest angle of railroad crossing; iron post stamped "63 Prim. Trav. Sta. No. 17" -----	U. S. C. & G. S.	63.160
Pomona, 8.6 miles north of, on southeast abutment of bridge over St. Johns River, 10 feet east of rail- road track and 1½ feet below it; top of iron rod that holds wooden structure in place, marked "9.7" -----	U. S. C. & G. S.	9.993
Pomona, 10.9 miles north of, 300 feet west of mile post, at crossroads; top joint of north rail marked "30" -----	U. S. C. & G. S.	30.2
Pomona, 11.6 miles north of, 20 feet south of railroad crossing, at base of southeast corner of signal tower; bolt marked "32.4" -----	U. S. C. & G. S.	32.72
Pomona, about 1.5 miles west of, in northeast angle of crossroads; nail in root of pine tree marked "66.7" -----	U. S. C. & G. S.	66.85
Pompano -----	F. E. C. Ry.	15.0
Ponce De Leon -----	L. & N. R. R.	62.3
Port Orange -----	F. E. C. Ry.	12.0
Port Sewall -----	F. E. C. Ry.	22.0

LOCALITY.	AUTHORITY.	Elevation Above Sea (feet).
Port Tampa -----	A. C. L. R. R.---	6
Possum Bluff -----	U. S. Army	
	Engrs., 1903---	21
Princeton -----	F. E. C. Ry.---	12.0
Prospect -----	A. C. L. R. R.---	143
Punta Gorda -----	A. C. L. R. R.---	3
Putnam Hall -----	G. S. & F. Ry.---	102
Putnam Hall, 50 feet north of railroad station, 10 feet east of four water oaks in a cluster; iron post stamped "106 Prim. Trav. Sta. Na. 28" -----	U. S. C. & G. S.---	105.568
Putnam Hall, 3.2 miles southwest of, 20 feet west of road forks, 200 feet south of lake; iron post stamped "102 Prim Trav. Sta. No. 29" -----	U. S. C. & G. S.---	102.243
Putnam Hall, 4.4 miles southwest of, 20 feet north- west of road forks, to southeast, 8 feet north of road; nail in root of pine tree, marked "149" ----	U. S. C. & G. S.---	149.15
Putnam Hall, 1 mile southwest of, opposite dim road west, 600 feet south of house, 3 feet east of road; nail in root of pine tree marked "94" -----	U. S. C. & G. S.---	93.97
Putnam Hall, 2.4 miles southwest of, 15 feet north of road, 300 feet south of lake; nail in top of pine stump marked "107.1" -----	U. S. C. & G. S.---	107.07
Puzzle Lake -----	U. S. Army	
	Engrs., 1903---	6
Quay -----	F. E. C. Ry.---	18.5
Quincy -----	G. F. & A. Ry.---	172
Quincy -----	S. A. L. Ry.---	245.9
Quincy, switch point of spur -----	S. A. L. Ry.---	239.4
Quincy, end of spur -----	S. A. L. Ry.---	145.6
Quincy, about opposite the east end of the Seaboard Air Line Railway station, 49 feet south of the main track -----	U. S. C. & G. S.---	243.054
Quincy, about 3 miles east of, 325 feet west of mile post 186, 26 feet south of the S. A. L. Ry., track, 975 feet east of an over-head road crossing -----	U. S. C. & G. S.---	218.182
Quincy, about 4 miles west of, 1625 feet west of mile post 193, near road crossing, 26 feet south of S. A. L. Ry., track -----	U. S. C. & G. S.---	275.941
Quintette -----	L. & N. R. R.---	120
Raiford -----	A. C. L. R. R.---	127
Raiford -----	U. S. G. S.---	129
Ramage Place, A. C. L. depot -----	U. S. G. S.---	109
Ratliff -----	U. S. G. S.---	23

ELEVATIONS IN FLORIDA.

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LOCALITY.	AUTHORITY.	Elevation Above Sea (feet).
Raulerson's -----	U. S. Army Engrs., 1903----	15
Reddick, A. C. L. depot -----	U. S. G. S.-----	92
Rice Creek, at railroad crossing opposite station; top joint of east rail, marked "10.3" -----	U. S. C. & G. S.--	10.3
Rice Creek, 0.8 mile north of station, 55 feet west of railroad track, just behind mile post, about 500 feet east of main Palatka-Bostwick road; iron post stamped "27" -----	U. S. C. & G. S.--	26.580
Richland -----	A. C. L. R. R.---	97
Riley -----	A. C. L. R. R.---	73
River Junction -----	L. & N. R. R.---	82.8
River Junction -----	S. A. L. Ry.---	78.2
River Junction, end of S. A. L. Ry., track at wharf on Apalachicola River -----	S. A. L. Ry.---	70.4
River Junction, 1,300 feet east of the Union Passen- ger station, bench mark is the highest point of the bolt in the northwest pillar of the railway water tank. It is 6 feet south of the main track. Marked U. S. B. M. -----	U. S. C. & G. S.--	76.096
River Junction, opposite the three-story brick build- ing, 975 feet northeast of the Union Passenger station. Bench mark is the highest point of a railroad rail (projecting 2½ feet) acting as a guard at the corner of sidewalk -----	U. S. C. & G. S.--	75.932
River Junction, about 1,138 feet west of the Union Passenger station, 325 feet west of the west end of the Seaboard Air Line and Atlantic Coast Line Railroad freight house, 98 feet south of the main track -----	U. S. C. & G. S.--	79.577
River Junction, about 2 miles west of, 211 feet west of west concrete pier of Louisville and Nashville Railroad bridge over the Apalachicola River, 3 feet north of trestle, bench mark is the top of a copper bolt set in a concrete post (U. S. E. No. 83) -----	U. S. Army Engrs., -----	63.786
River Junction, about 2 miles west of, in the triangle formed by three blazed trees; one of which is a 20-inch white oak, distant 20 feet; another is a 24-inch post oak, distant 100 feet; and the other is a 10-inch walnut, distant 127 feet. The bench mark is a copper bolt in a concrete post, 325 feet southwest of the west concrete pier at the west end of the Louisville and Nashville Railroad		

LOCALITY.	AUTHORITY.	Elevation Above Sea (feet).
bridge over the Apalachicola River, and about 10 feet from the bank of the river. (U. S. E. No. 84) -----	U. S. Army Engrs., -----	64.062
Riverland -----	A. C. L. R. R.-----	76
Riviera -----	F. E. C. Ry.-----	19.4
Roberts -----	L. & N. R. R.-----	144.3
Rochelle, A. C. L. depot -----	U. S. G. S.-----	80
Rochelle, north end of one-story dwelling owned by S. S. Phifer; copper bolt set in brick chimney (Coast and Geodetic Survey bench mark) -----	U. S. C. & G. S.-----	83.165
Rochelle, 15 feet southeast of main entrance to school- house; iron post stamped "83 Prim. Trav. Sta. No. 40" -----	U. S. C. & G. S.-----	82.703
Rochelle, 4 miles south of, in southwest corner of railroad crossing; iron post stamped "72 Prim. Trav. Sta. No. 41" -----	U. S. C. & G. S.-----	72.442
Rochelle, 5 miles south of, 20 feet northeast of rail- road crossing; top of a piece of iron rail driven in ground, marked "68" -----	U. S. C. & G. S.-----	67.59
Rochelle, 1 mile north of, in southwest angle of road to west; nail in root of pine tree, marked "98.3" --	U. S. C. & G. S.-----	98.32
Rochelle, 2.4 miles north of, 400 feet north of culvert, 300 feet south of second-class road west, 8 feet west of road; nail in root of water oak tree, marked "91.6" -----	U. S. C. & G. S.-----	91.60
Rochelle, 3 miles north of, 20 feet west of road forks, to northwest; nail in root of pine tree, marked "88.7" -----	U. S. C. & G. S.-----	88.74
Rockdale -----	F. E. C. Ry.-----	13.0
Rock Harbor -----	F. E. C. Ry.-----	12.4
Rock Island -----	U. S. Army Engrs., 1903---	12
Rockledge -----	F. E. C. Ry.-----	29.0
Rock Springs, A. C. L. depot -----	U. S. G. S.-----	75
Rodman, on top of west concrete foundation for iron gate post, southeast corner of park; cross in con- crete, marked "28.6" -----	U. S. C. & G. S.-----	28.37
Rodman, 3.3 miles northeast of, in southeast corner of crossing of old Palatka-Rodman road and Wilson Lumber Co. tramway; iron post stamped "27 Prim. Trav. Sta. No. 39" -----	U. S. C. & G. S.-----	27.110
Rodman, 2.04 miles southeast of, in southeast corner of crossroads, 250 feet south of drain crossing; nail		

LOCALITY.	AUTHORITY.	Elevation Above Sea (feet).
in root of pine tree, marked "21.5" unchecked	U. S. C. & G. S.	21.24
Rodman, 3.5 miles east of, 20 feet east of road, pine tree located as primary traverse point, marked "P. T." in large white letters and bearing warning sign marked "21.2"; nail in root, unchecked	U. S. C. & G. S.	20.97
Rodman, 4.6 miles southeast of, at Turpentine Landing, 30 feet southeast of road forks to north, 20 feet east of road; iron post stamped "9 Prim. Trav. Sta. No. 38" unchecked	U. S. C. & G. S.	8.952
Rodman, 4.4 miles northeast of, in southeast angle of road forks to east; nail in root of pine tree, marked "27.2"	U. S. C. & G. S.	26.91
Rodman, 6 miles northeast of, 25 feet southwest of road forks to southwest, 300 feet south of old house at road forks to west; nail in root of pine tree, marked "42.5"	U. S. C. & G. S.	42.23
Rogers	F. E. C. Ry.	41.7
Roky	L. & N. R. R.	112.3
Romeo, A. C. L. depot	U. S. G. S.	42
Roseland	F. E. C. Ry.	18.6
Rosewood, S. A. L. depot	U. S. G. S.	16
Rosewood, near front of store and post office, inside fence, near west side of front porch; bottom of a square cut in top of an artificial stone post 8 by 8 by 36 inches, buried 30 inches in ground and lettered "U. S. C. & "G. S. B. M." (C. & G. S. "Rosewood")	U. S. C. & G. S.	14.570
Rosewood, about 1.5 miles east of, near second telegraph pole east of mile post 144, 10 meters north of Seaboard Air Line Railway tracks	U. S. C. & G. S.	16.175
Round Lake, maximum elevation near on profile of Atlanta and St. Andrews Bay Railway	A. & ST. A. B. Ry.	322
Roy in southeast corner of A. E. Campbell's yard, 150 feet south of railroad crossing; iron post stamped "23 Prim. Trav. Sta. No. 10"	U. S. C. & G. S.	23.345
Roy, 1 mile south of, about 600 feet south of second-class road crossing, 25 feet east of road; nail in root of pine tree, marked 25.4	U. S. C. & G. S.	25.48
Roy, 2.7 miles south of, 700 feet south of two-story house, in north angle of road forks to northwest; iron post stamped "27 Prim. Trav. Sta. No. 11"	U. S. C. & G. S.	27.479

LOCALITY.	AUTHORITY.	Elevation Above Sea (feet).
Roy, 5 miles south of, in south angle of road forks to southwest; nail in root of pine tree, marked "21.8" -----	U. S. C. & G. S..	21.94
Roy, 6.2 miles south of, 6 feet east of road; marked "20.2" -----	U. S. C. & G. S..	20.27
Roy, 7.4 miles south of, 6 feet east of road; nail in root of pine tree, marked "14.2" -----	U. S. C. & G. S..	14.29
Roy, 8 miles south of, about 1.2 miles north of Schell's Bluff, in northeast angle of T road north; iron post stamped "6Prim. Trav. Sta. No. 12" -----	U. S. C. & G. S..	6.191
Runnymede -----	A. C. L. R. R.---	72
Russell, about ½ mile northwest of on A. C. L. R. R. -	U. S. G. S.-----	13
Saint Augustine, 700 feet north of San Sebastian River bridge -----	F. E. C. Ry.----	6.7
Saint Augustine, 5½ miles north of, at Magnolia Grove, 30 meters east of telephone booth, in line with telegraph poles -----	U. S. C. & G. S..	10.709
Saint Augustine, about 2.7 miles north of, just north of mile post "Jax 34," 8 meters west of Florida East Coast Railway tracks, in line with telegraph poles, said mile post 60 meters north of road cross- ing -----	U. S. C. & G. S..	9.363
Saint Augustine, A standard disk bench mark set in the granite coping to sea wall in front of St. Augustine, It is 100 feet north of Capo's wharf which is at foot of Hypolita Street. B. M. 9 is the surface of the disk at its center. The upper surface of the disk is even with the surface of the coping -----	U. S. C. & G. S..	6.650
Saint Augustine, Established for temporary use It is the upper surface of a 60d spike driven in the outer face of the sea wall in front of the city, at the foot of Hypolita Street, just north of Paul Capo's wharf. Two other spikes were driven into the wall, at an angle, to support the spike used as the B. M. -----	U. S. C. & G. S..	1.175
Saint Augustine, The top slide of a portable staff erected at foot of Hypolita Street. Upon this B. M. rests the brass angles that are fastened to the staff, when the staff is in position for use, The staff was installed in March, 1914 -----	U. S. C. & G. S..	4.016

LOCALITY.	AUTHORITY.	Elevation Above Sea (feet).
Saint Augustine, about six inches from east and south edges of granite coping of sea wall, at corner of entrance to basin opposite plaza; cut (C. & G. S. "Fairfield")	U. S. C. & G. S.	7.256
Saint Augustine, in vertical face of sea wall about 1.5 feet from base 28.2 feet south of wharf; triangle with hole in center (C. & G. S. "Hitchcock")	U. S. C. & G. S.	1.307
Saint Augustine, in face of sea wall, 1.9 meters below top, few feet south of bench mark A., of wall; upper surface of iron rod 1 inch square (C. & G. S. "Tidal")	U. S. C. & G. S.	0.872
Saint Augustine, near center of top of granite coping of sea wall, 3 feet south of south side of basin opposite plaza; bottom of square cut lettered "U. S. C. & "G. S. B. M." (C. & G. S. "A")	U. S. C. & G. S.	7.046
Saint Augustine, granite coping of sea wall, near southwest corner of sixty-seventh stone south of south side of basin opposite plaza, 107 meters south of basin; surface of a smooth place 2 by 2 inches, lettered "U. S." "B. M." (C. & G. S. "B")	U. S. C. & G. S.	6.689
Saint Augustine, at southeast corner of United States reservation west of Plaza, bottom of square cut in top of marble post. Edges of top of post are broken off. (C. & G. S. "C")	U. S. C. & G. S.	7.896
Saint Augustine, United States reservation, west of west end of customhouse, near building, at center of marble post 8 by 8 inches by 3 feet, buried in ground 30 inches; bottom of a square cut lettered "U. S. C. & "G. S. B. M." (C. & G. S. "D")	U. S. C. & G. S.	7.885
Saint Catherine	A. C. L. R. R.	66
Saint Cloud	A. C. L. R. R.	63
Saint Johns River, at mile post 23 on the Okeechobee division	F. E. C. Ry.	16.4
Saint Leo	A. C. L. R. R.	140
Saint Lucie	F. E. C. Ry.	11.0
Saint Lucie River, at mile post 261	F. E. C. Ry.	13.9
Saint Marks	S. A. L. Ry.	8
Saint Marys River, at crossing of on G. S. & F. Ry., near Baxter, at mile post 223, Georgia-Florida boundary line	G. S. & F. Ry.	111
Saint Marys River, at crossing of near St. George, Ga., on the G. S. & F. Ry., between mile posts 235 and 236	G. S. & F. Ry.	50

LOCALITY.	AUTHORITY.	Elevation Above Sea (feet).
Saint Nicholas -----	F. E. C. Ry.-----	23.0
Saint Nicholas -----	U. S. G. S.-----	25
Saint Petersburg -----	A. C. L. R. R.-----	20
Salerno -----	F. E. C. Ry.-----	11.4
Salt Lake -----	U. S. Army	
	Engrs., 1903---	7
Salt Lake Run -----	U. S. Army	
	Engrs., 1903---	7
Sampson, about 100 meters north of the booth, 12 meters east of Florida East Coast Railway tracks, in line with telegraph poles -----	U. S. C. & G. S.-	37.756
Sampson, about 2 1/2 miles northwest of, on F. E. C. Ry. -----	U. S. G. S.-----	40
Sampson City -----	G. S. & F. Ry.-----	146
San Antonio -----	A. C. L. R. R.-----	165
Sanderson -----	S. A. L. Ry.-----	154.6
Sanderson, about 50 meters east of the station, 8 me- ters north of the Seaboard Air Line Railway tracks, in line with telegraph poles -----	U. S. C. & G. S.-	156.529
Sanderson, about 3 miles west of, at mile post C169, 8 meters north of Seaboard Air Line Railway tracks, in line with telegraph poles -----	U. S. C. & G. S.-	167.631
Sanderson, about 6 miles west of, at mile post C166, in line with telegraph poles, 8 meters north of Seaboard Air Line Railway tracks -----	U. S. C. & G. S.-	174.002
Sanford -----	A. C. L. R. R.-----	20
Sanford -----	U. S. Army	
	Engrs., 1903---	6
San Mateo -----	F. E. C. Ry.-----	69.2
San Mateo -----	U. S. G. S.-----	66
San Pablo -----	F. E. C. Ry.-----	11.3
San Pablo -----	U. S. G. S.-----	9
Sarta Fe -----	A. C. L. R. R.-----	45
Santos, S. A. L. depot -----	U. S. G. S.-----	69
Sapp -----	U. S. G. S.-----	140
Satsuma, 150 feet west of station, in southwest corner of yard, 50 feet east of railroad track; iron post stamped "78 Prim Trav. Sta. No. 15" -----	U. S. C. & G. S.-	78.664
Satsuma, 1.1 miles southwest of, at top of rise, 300 feet south of house, 10 feet east of road; nail in root of water oak tree, marked "93.4" -----	U. S. C. & G. S.-	93.63

LOCALITY.	AUTHORITY.	Elevation Above Sea (feet).
Satsuma, 2.8 miles southwest of, in southwest corner of road forks, 150 feet southeast of schoolhouse, near signboard 'Satsuma 2½ mi., Sisco 2 mi., "600 feet north of Nashua post office; nail in root of tree, marked "87.8" -----	U. S. C. & G. S.-	87.99
Satsuma, 4.3 miles southwest of, in southeast corner of road crossing; nail in root of large pine tree, marked "31.1" -----	U. S. C. & G. S.-	31.30
Satsuma, 5.3 miles southwest of, 75 feet northwest of entrance to Oakwood Cemetery, in sharp angle of road to west; nail in root of pine tree, marked "24.5" -----	U. S. C. & G. S.-	24.73
Saxton, 400 feet north of railroad crossing, 30 feet west of Seaboard Air Line Ry., track, 50 feet northeast of one-story frame dwelling, on outer corner of fence; iron post stamped "165 Prim. Trav. Sta. 69" -----	U. S. C. & G. S.-	164.403
*Saxton 4.2 miles west of, 8 feet west of Starke-Sanderson road, 150 feet north of mail boxes 26 and 27, in southwest corner of second-class road crossing, at corner of picket fence, 100 feet northeast of one story frame dwelling; iron post stamped "141 Prim. Trav. Sta. No. 70" -----	U. S. C. & G. S.-	139.354
*Saxton, 5.4 miles west of, 50 feet south of sharp turn of road to west; nail in root of pine tree, marked "149" -----	U. S. C. & G. S.-	147.30
*Saxton, 6.2 miles west of, 50 feet south of road forks to southeast, 100 feet southeast of culvert; nail in root of pine tree, marked "139.1" -----	U. S. C. & G. S.-	137.51
*Saxton, 7.2 miles west of, on Starke-Raiford road, in northwest angle of road to north, 400 feet east of house, about same distance southeast of mail box No. 44; iron post stamped "139 Prim Trav Sta. No. 71" -----	U. S. C. & G. S.-	137.205
Saxton, 8.6 miles west of, 400 feet southeast of road forks, 200 feet west of Anderbilt schoolhouse, 8 feet west of road; nail in root of pine tree, marked "142.1" -----	U. S. C. & G. S.-	140.50
*Saxton, 9.6 miles west of, in west corner of cross-roads, 300 feet west of house; nail in root of pine tree, marked "142.3" -----	U. S. C. & G. S.-	140.65
*Saxton, 10.8 miles west of, on Starke-Lake Butler road, about 7 miles west of Starke, in west angle of road to southwest; iron post stamped "149		

LOCALITY.	AUTHORITY.	Elevation Above Sea (feet).
Prim. Trav. Sta. No. 72" -----	U. S. C. & G. S.	147.854
Schells Bluff, 1 mile northwest of, in northeast angle of road forks southwest, 25 feet east of road; nail in root of pine tree, marked "10.2" -----	U. S. C. & G. S.	10.33
Schells Bluff, 2.1 miles northwest of, 300 feet south of second-class road west, 30 feet west of road; nail in root of pine tree, marked "17.5" -----	U. S. C. & G. S.	17.65
Schells Bluff, 2.5 miles northwest of, 50 feet south of creek, in southeast corner of sharp turn in road to east, in inner corner of fence; iron post stamp- ed "12 Prim. Trav. Sta. No. 13" -----	U. S. C. & G. S.	12.014
Schells Bluff, 3.6 miles northwest of, 6 feet east of road; nail in root of dead-top pine, marked "25.4" -----	U. S. C. & G. S.	25.55
Schells Bluff, 4.7 miles northwest of, 6 feet east of road and 30 feet south of forks, 100 feet east of lake; nail in root of pine tree, marked "27.4" -----	U. S. C. & G. S.	27.52
Schells Bluff, 5.9 miles northwest of, 6 feet south of road; nail in root of pine tree, marked "29.5" -----	U. S. C. & G. S.	29.66
Schells Bluff, 7.3 miles northwest of, 300 feet west of road forks to southwest, 6 feet north of road; nail in root of pine tree, marked "22.2" -----	U. S. C. & G. S.	22.34
Schells Bluff, 8.6 miles northwest of, about 1.2 miles south of San Mateo, 200 feet north of bridge over creek, 20 feet east of road; iron post stamped "15 Prim. Trav. Sta. No. 14" -----	U. S. C. & G. S.	15.351
Schells Bluff, 9.9 miles northwest of, about 1.5 miles east of bridge over Dunn's Creek, 20 feet east of road; nail in root of pine tree, marked "13" -----	U. S. C. & G. S.	13.18
Schells Bluff, 11.3 miles northwest of, on northeast abutment of bridge over Dunn's Creek; chiseled square in concrete marked "3.90" -----	U. S. C. & G. S.	4.14
Sebastian -----	F. E. C. Ry.	21.3
Sebastian River, between mile posts 212 and 213 -----	F. E. C. Ry.	17.5
Sedalia -----	A. N. R. R.	218
Seffner -----	A. C. L. R. R.	74
Sellman -----	A. C. L. R. R.	45
Seville -----	A. C. L. R. R.	53
Sharon -----	G. S. F. Ry.	153
Sharpes -----	F. E. C. Ry.	36.6
Shiloh -----	F. E. C. Ry.	8.3
Shingle Creek -----	A. C. L. R. R.	79.6
Silver Springs, S. A. L. depot -----	U. S. G. S.	47
Silver Springs Junction -----	U. S. G. S.	65

LOCALITY.	AUTHORITY.	Elevation Above Sea (feet).
Simpson Branch -----	L. & N. R. R.---	198
Sims Creek, Putnam County, about 3.4 miles west of Bostwick, center of bridge over; marked "33.4" --	U. S. C. & G. S.--	33.4
Sisco -----	U. S. G. S.-----	68
Six-Mile Creek, Duval County, between mile posts 256 and 257 on the G. S. & F. Ry. -----	G. S. & F. Ry.---	12
Skinner, about 1¾ miles east of Bowden, Duval County -----	U. S. G. S.-----	21
Smith Bridge, across St. Marys River, about 5½ miles north of Macclenny -----	U. S. G. S.-----	90
Snake Creek, Monroe County, between mile posts 437 and 438 -----	F. E. C. Ry.-----	11.3
Sneads -----	L. & N. R. R.---	114.8
South Jacksonville. -----	F. E. C. Ry.-----	7.9
South Jacksonville, in the south face of the Thomas building, on the southeast corner of, at Louisa Street and Myrtle Avenue -----	U. S. C. & G. S.--	9.350
South Jacksonville, in the west face of the Bank of South Jacksonville, on the northeast corner of, at Hendricks Avenue and St. Johns Avenue -----	U. S. C. & G. S.--	9.993
South Side -----	F. E. C. Ry.-----	15.8
Spanish Harbor -----	F. E. C. Ry.-----	9.4
Spencer, A. C. L. depot -----	U. S. G. S.-----	94
Spring Garden -----	A. C. L. R. R.---	17
Spring Glen -----	U. S. G. S.-----	13
Spring Hill -----	G. F. & A. Ry.---	93.3
Springside -----	G. S. & F. Ry.---	15
Springside, 150 feet southwest of railroad crossing, at southeast corner of L. M. Upchurch's store; iron post stamped "14 Prim Trav. Sta. No. 14" -----	U. S. C. & G. S.--	13.520
Springside, 0.8 mile west of, at second-class railroad crossing; joint of north rail, marked "16" -----	U. S. C. & G. S.--	16.0
Spruce Creek, Volusia County, 276 feet north of, at mile post 119 -----	F. E. C. Ry.-----	8.9
Spuds -----	F. E. C. Ry.-----	24.0
Stanton -----	A. C. L. R. R.---	83
Starke -----	S. A. L. Ry.---	150
Starke, 30 meters southwest of station, 12 meters east of Seaboard Air Line Railway tracks, 4 meters north of railroad crossing sign, in line with tele- graph poles -----	U. S. C. & G. S.--	164.950
Statens -----	A. C. L. R. R.---	111
Steckert -----	U. S. G. S.-----	148

LOCALITY.	AUTHORITY.	Elevation Above Sea (feet).
Still Creek, Leon County, between mile posts 149 and 150 -----	S. A. L. Ry.	66.9
Stuart -----	F. E. C. Ry.	14.9
Sumatra -----	A. N. R. R.	22
Summerfield -----	S. A. L. Ry.	85
Summerville -----	L. & N. R. R.	241.8
Sumner, S. A. L. depot -----	U. S. G. S.	9
Sumner, 26 meters west of station, 30 meters south-east of mile post 148 and 14 meters south of Seaboard Air Line Railway tracks -----	U. S. C. & G. S.	7.133
Sunbeam -----	F. E. C. Ry.	26.4
Sunbeam, 30 meters north of station, 10 meters east of Florida East Coast Railway tracks, in line with telegraph poles -----	U. S. C. & G. S.	25.381
	U. S. Army	
Sunset Lake -----	Engrs., 1903.	10
Suwannee -----	A. C. L. R. R.	152
Suwannee River bridge near Ellaville -----	S. A. L. Ry.	67.9
Suwannee River bridge near White Springs -----	G. S. & F. Ry.	95
Suwannee Valley -----	G. S. & F. Ry.	106
Svea -----	L. & N. R. R.	241
Swift Creek, Hamilton County, between mile posts 195 and 196 -----	G. S. & F. Ry.	111
Tallahassee -----	G. F. & A. Ry.	80.6
Tallahassee -----	S. A. L. Ry.	78.8
Tallahassee, switch point of St. Marks branch -----	S. A. L. Ry.	69.3
Tallahassee, at G. F. & A. Ry., crossing -----	S. A. L. Ry.	64.6
Tallahassee, in the southwest footing of the S. A. L. Ry., water tank near the passenger station; bench mark is the top of an iron anchor bolt marked by a cross -----	U. S. C. & G. S.	80.269
Tallahassee, in the southeast corner of the Supreme Court Building -----	U. S. C. & G. S.	188.110
Tallahassee, in the northeast corner of the State Capitol Building -----	U. S. C. & G. S.	214.931
Tallahassee, in the southeast corner of the brick building used by the State Savings Bank -----	U. S. C. & G. S.	216.040
Tallahassee, about 7 miles east of, at mile post 158, 8 meters north of the Seaboard Air Line Railway tracks -----	U. S. C. & G. S.	49.009
Tallahassee, about 3½ miles east of, about a half mile east of mile post 162; 13 feet east of a road crossing; 26 feet north of the S. A. L. Ry., tracks -----	U. S. C. & G. S.	89.386

LOCALITY.	AUTHORITY.	Elevation Above Sea (feet).
Tallahassee, about four miles west of, near private road crossing, about $\frac{1}{2}$ mile west of mile post 169; 26 feet north of S. A. L. Ry., track -----	U. S. C. & G. S.	65.968
Tallahassee, about $7\frac{1}{2}$ miles west of, near a private road crossing, about 1-3 mile west of mile post 172, 26 feet south of S. A. L. Ry., track -----	U. S. C. & G. S.	135.836
Tallahassee, about $3\frac{1}{2}$ miles northwest of the Georgia, Florida and Alabama Railway station, about 1,344 feet northwest of mile post 53; 98 feet west of a private road crossing; 30 feet north of G. F. & A. Ry., tracks. Concrete post -----	U. S. C. & G. S.	89.353
Tallahassee, about seven miles northwest of, just east of a railroad cut, 26 feet north of G. F. & A. Ry., tracks. Concrete post -----	U. S. C. & G. S.	104.147
Tallahassee, about $10\frac{1}{2}$ miles northwest of, about 1-3 mile northwest of mile post 60, 26 feet north of G. F. & A. Ry., tracks; at west end of railway cut. Concrete post -----	U. S. C. & G. S.	113.950
Tampa -----	A. C. L. R. R.	15
Tarpon Springs -----	A. C. L. R. R.	14
Tarrytown -----	A. C. L. R. R.	82
Tavares -----	A. C. L. R. R.	66
Tavernier -----	F. E. C. Ry.	10.3
Tavernier Creek, Monroe County, between mile posts 432 and 433 -----	F. E. C. Ry.	10.0
Taylor Branch, Okeechobee County, Between mile posts 123 and 124 on the Okeechobee division --	F. E. C. Ry.	59.2
Taylor Creek, Okeechobee County, between mile posts 135 and 136 on the Okeechobee division -----	F. E. C. Ry.	29.9
Teasdale, railroad crossing; top of rail -----	U. S. C. & G. S.	65.5
Telogia -----	A. N. R. R.	116
Telogia Creek, south crossing of A. N. R. R. -----	A. N. R. R.	45
Telogia Creek, north crossing of A. N. R. R. -----	A. N. R. R.	165
Theressa -----	G. S. & F. Ry.	154
*Theressa, 150 feet south of railroad station, 30 feet southwest of railroad crossing, at northeast corner of one-story dwelling house; iron post stamped "168 Prim. Trav. Sta. No. 80" -----	U. S. C. & G. S.	166.181
*Theressa, 0.8 mile east of, in southeast corner of intersection of Starke-Melrose and Theressa-Spring Lake roads; nail in root of pine stump, marked "164.2" -----	U. S. C. & G. S.	162.66
*Theressa, 2.1 miles east of, 25 feet north of road forks to southeast; iron post stamped "191 Prim. Trav. Sta. No. 81" -----	U. S. C. & G. S.	189.837

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LOCALITY.	AUTHORITY.	Elevation Above Sea (feet).
*Theressa, 3.3 miles east of, 150 feet north of road forks, 10 feet east of road; nail in root of charred pine stump, marked "188.7" -----	U. S. C. & G. S.	187.11
Thomas Creek, Duval County, between mile posts 248 and 249 on the G. S. & F. Ry. -----	G. S. & F. Ry.	20
Thomasville -----	S. A. L. Ry.	84
Thonotosassa -----	A. C. L. R. Ry.	49
Tibbals -----	F. E. C. Ry.	31
Tiger Lake, Polk County, -----	U. S. Army Engrs, 1882	59
Tildenville -----	A. C. L. R. Ry.	99
Tillman -----	F. E. C. Ry.	18.0
Tisonia, 70 meters north of station, 50 meters south of mile post 17, 18 meters east of Seaboard Air Line Railway tracks -----	U. S. C. & G. S.	30.216
Titusville -----	F. E. C. Ry.	14.8
Tocoi Junction, yard of residence of Mr. H. Wood, near southeast corner of house, at center of ar- tificial stone post 8 by 8 inches in cross section and 3 feet long, projecting 6 inches above surface and lettered "U. S. B. M."; square cut (C. & G. S. "E") -----	U. S. C. & G. S.	35.583
Tohopkee -----	F. E. C. Ry.	78.7
Tomoka River, Volusia County, between mile posts 101 and 102 -----	F. E. C. Ry.	10.5
Toms Harbor -----	F. E. C. Ry.	13.3
Toronto -----	A. C. L. R. Ry.	117
Trilby -----	A. C. L. R. Ry.	69
Tsala Apopka Lake -----	U. S. G. S.	50
Tulane -----	U. S. G. S.	76
Turkey Creek -----	S. A. L. Ry.	87
Turkey Creek, Brevard County, between mile posts 197 and 198 -----	F. E. C. Ry.	17.5
Turnbull Bay, Volusia County, between mile posts 121 and 122 -----	F. E. C. Ry.	8.7
Tuscawilla Lake -----	U. S. G. S.	80
Twin Oaks -----	F. E. C. Ry.	47.8
Valkaria -----	F. E. C. Ry.	11.0
Valle -----	L. & N. R. Ry.	64.3
Varnes -----	A. C. L. R. Ry.	143
Verdie, S. A. L. depot -----	U. S. G. S.	75
Vero -----	F. E. C. Ry.	19.5
Vero, drainage canal north of -----	F. E. C. Ry.	18.5
Volusia -----	F. E. C. Ry.	32.0

LOCALITY.	AUTHORITY.	Elevation Above Sea (feet).
Wabasso -----	F. E. C. Ry.	20.5
Waccassassa River -----	A. C. L. R. R.	27
Wade -----	A. C. L. R. R.	69
Wainwright -----	S. A. L. Ry.	129
Wakulla -----	S. A. L. Ry.	22
Waldo -----	S. A. L. Ry.	150
Waldo, 30 meters west and 12 meters north of station, 8 meters east of street, 15 meters from corner of Waldo Hotel, on Seaboard Air Line Railway right of way -----	U. S. C. & G. S.	155.252
Waldo, southeast corner of school building; iron post stamped 'Prim. Trav. Sta. No. 57' -----	U. S. C. & G. S.	156.430
Waldo, about 3 miles northeast of, 100 meters north of mile post 82, 20 meters west of Seaboard Air Line Railway track; in line with telegraph poles, near road crossing -----	U. S. C. & G. S.	141.807
Waldo, 7.9 miles southeast of, 10 feet north of road forks to southwest, about 1.5 miles northwest of Melrose; nail in root of pine tree -----	U. S. C. & G. S.	145.31
*Waldo, 1.2 miles southeast of, 600 feet east of culvert, in east corner of road forks to northeast; nail in root of pine tree, marked "142.5" -----	U. S. C. & G. S.	142.55
*Waldo, 2.2 miles southeast of, in northeast angle of road forks, 250 feet south of house; nail in root of water oak tree, marked "157.4" -----	U. S. C. & G. S.	157.54
*Waldo, 3.4 miles southeast of, in southeast corner of crossroads, at southwest corner of church; iron post stamped "171 Prim. Trav. Sta. No. 58" -----	U. S. C. & G. S.	171.133
*Waldo, 4.6 miles southeast of, 100 feet north of crossroads, 10 feet east of road and 150 feet north of fence corner; nail in root of pine tree, marked "156.2" -----	U. S. C. & G. S.	156.28
*Waldo, 5.8 miles southeast of, in southwest angle of road to east; nail in root of pine tree, marked "190" -----	U. S. C. & G. S.	190.11
*Waldo, 6.8 miles southeast of, in northwest angle of road forks to west, about 3 miles northwest of Melrose; iron post stamped "188 Prim Trav. Sta. No. 59" -----	U. S. C. & G. S.	188.457
Walk in the Water Lake, Polk County -----	U. S. Army Engrs., 1882	68
Ward City -----	S. A. L. Ry.	118
Walton -----	F. E. C. Ry.	33.5
Watertown -----	S. A. L. Ry.	191.5

LOCALITY.	AUTHORITY.	Elevation Above Sea (feet).
Watertown, about 1 mile east of, near mile post Cr53, 8 meters north of Seaboard Air Line Railway tracks -----	U. S. C. & G. S.	201.345
Wauchula -----	A. C. L. R. R.	107
Webster -----	A. C. L. R. R.	89
Wekiva River -----	A. C. L. R. R.	29
Wekiva River, north fork -----	A. C. L. R. R.	29
Welaka, in southwest angle of two cross streets, corner of Winston Steven's yard; iron post stamped "27 Prim. Trav. Sta. No. 16" -----	U. S. C. & G. S.	26.886
Welaka, 1.1 miles east of, in southeast corner of sec- ond-class road crossing; nail in root of water oak tree, marked "53.2" -----	U. S. C. & G. S.	53.36
Welaka, 3 miles east of, at top of hill, 300 feet east of crossroads, 15 feet north of road; nail in root of water oak tree, marked "55.5" -----	U. S. C. & G. S.	55.70
Welaka, 3.9 miles east of, in northeast angle of cross- roads, about 1.5 miles west of Pomona; nail in root of pine tree, marked "66.7" -----	U. S. C. & G. S.	66.85
Welborn -----	S. A. L. Ry.	192.7
Welborn, 50 meters northwest of Seaboard Air Line Railway station, 10 meters south of track -----	U. S. C. & G. S.	192.713
Welborn, about 3 miles west of, near mile post Cr35, 8 meters north of Seaboard Air Line Railway tracks -----	U. S. C. & G. S.	186.430
Welshton, A. C. L. depot -----	U. S. G. S.	82
West Farm -----	S. A. L. Ry.	103.8
West Farm, 30 meters west of Seaboard Air Line Railway station, 6 meters south of main track ---	U. S. C. & G. S.	104.980
West Jupiter -----	F. E. C. Ry.	9
West Palm Beach -----	F. E. C. Ry.	20.4
West Toco -----	A. C. L. R. R.	12
Westville -----	L. & N. R. R.	64.3
White City -----	F. E. C. Ry.	32.5
White House -----	S. A. L. Ry.	80.9
White House, about 4 miles west of, near mile post Cr94, 6 meters north of Seaboard Air Line Rail- way tracks -----	U. S. C. & G. S.	85.203
White House, 22 meters west of station, 7 meters south of Seaboard Air Line Railway tracks, near railway crossing sign -----	U. S. C. & G. S.	85.151
White Springs -----	G. S. & F. Ry.	126
Whitesville, A. C. L. depot -----	U. S. G. S.	122

LOCALITY.	AUTHORITY.	Elevation Above Sea (feet).
Wilcox Junction -----	A. C. L. R. R.---	24.0
Wildwood -----	S. A. L. Ry.---	58
Williamson -----	L. & N. R. R.---	226
Wilma -----	A. N. R. R.---	62
Windermere -----	A. C. L. R. R.---	119.8
Windsor, in northeast corner of crossroads; iron post stamped "114 Prim. Trav. Sta. No. 52" -----	U. S. C. & G. S.---	114.293
Windsor, 1.32 miles northwest of, 6 feet north of road; nail in root of pine tree, marked "83" -----	U. S. C. & G. S.---	83.05
Windsor, 2.9 miles northwest of, 300 feet south of drain, 10 feet west of road; nail in root of pine tree, marked "80.1" -----	U. S. C. & G. S.---	80.13
Windsor, 3.6 miles northwest of, 300 feet west of west end of bridge over Big Hatchet Creek, in northeast corner of T road north; iron post stamp- ed "78 Prim. Trav. Sta. No. 53" -----	U. S. C. & G. S.---	77.743
Windsor, 4.7 miles northwest of, 25 feet south of road, 100 feet southeast of drain; nail in root of pine tree, marked "95.9" -----	U. S. C. & G. S.---	95.95
Windsor, 5.4 miles northwest of, in southeast angle of road forks to south, 600 feet north of house; iron post stamped "115 Prim. Trav. Sta. No. 54" -----	U. S. C. & G. S.---	115.423
Winfield -----	G. S. & F. Ry.---	148
Winn -----	G. S. & F. Ry.---	137
Winston -----	A. C. L. R. R.---	139
Winter Garden -----	A. C. L. R. R.---	123
Winter Park -----	A. C. L. R. R.---	96
Woodburn -----	G. S. & F. Ry.---	16
Woodburn, 5.7 miles northwest of, 50 feet west of road forks, about 500 feet northwest of old shack; nail in root of red oak tree marked, "92.4" -----	U. S. C. & G. S.---	92.44
Woodburn, 6.6 miles northwest of, in south angle of road forks south, 100 feet east of bridge over Sims Creek. (Bench mark set by a canal survey of the War Department; it is a pile of concrete with a tin can at the top. In center of can is a nail marked "U. S. B. M." -----	U. S. C. & G. S.---	50.76
Woodburn, 7.7 miles northwest of, in southwest corner of crossroads, 600 feet southeast of house; nail in root of pine tree, marked "112.1" -----	U. S. C. & G. S.---	112.11
Woodburn, 8.9 miles northwest of, 100 feet southwest of creek crossing, 12 feet south of road; iron post stamped "72 Prim. Trav. Sta. 25" -----	U. S. C. & G. S.---	71.623

LOCALITY.	AUTHORITY.	Elevation Above Sea (feet).
Woodburn, 10.3 miles northwest of, in southeast angle of road forks to northeast; nail in root of red oak tree, marked "126.5" -----	U. S. C. & G. S.	126.44
Woodburn, 11.8 miles west of, 6 feet north of road, about 0.2 mile northeast of Florahome-Palatka road; nail in root of water oak, marked "91" ----	U. S. C. & G. S.	91.00
Woodburn, 30 feet south of railroad crossing, at in- side corner of wire fence, west of road; iron post stamped "15 Prim. Trav. Sta. No. 19" -----	U. S. C. & G. S.	14.600
Woodburn, 1.4 miles north of, 150 feet south of cross- roads, 10 feet east of road; nail in root of pine tree, marked "24.7" -----	U. S. C. & G. S.	24.67
Woodburn, 2.6 miles north of, in southwest angle of road forks south; nail in root of pine tree, marked "31.5" -----	U. S. C. & G. S.	31.50
Woodburn, 4.7 miles northwest of, in northeast corner of road crossing, about 2 miles north of Carraway station; iron post stamped "89 Prim. Trav. Sta. No. 20" -----	U. S. C. & G. S.	88.654
Woodland, opposite switch stand at south end of sid- ing, 10 meters west of Florida East Coast Rail- way tracks, near private road crossing -----	U. S. C. & G. S.	39.665
Woodstock -----	S. A. L. Ry.	161.2
Woodville -----	S. A. L. Ry.	26
Worthington Springs -----	A. C. L. R. R.	66
Wyllie, about 3.5 miles northeast of, near mile post 140, 9 meters north of Seaboard Air Line Rail- way tracks -----	U. S. C. & G. S.	16.171
Ybor City -----	A. C. L. R. R.	20
Yamato -----	F. E. C. Ry.	20.8
Yelvington -----	F. E. C. Ry.	33.0
Yelvington -----	U. S. G. S.	32
York, A. C. L. depot -----	U. S. G. S.	84
Yniestra -----	L. & N. R. R.	5.3
Yulee, about 2.7 miles south of, 200 meters north of shack in clump of trees on north side of a large swamp, 12 meters east of Seaboard Air Line Rail- way tracks -----	U. S. C. & G. S.	11.204
Yulee, 70 meters east of railway water tank, 17 meters northeast of the Savannah-Jacksonville line and 35 meters southeast of the Baldwin-Fernandina line of the Seaboard Air Line Railway -----	U. S. C. & G. S.	35.692
Zellwood -----	S. A. L. Ry.	95
Zolfo Springs -----	A. C. L. R. R.	61
Zion -----	A. N. R. R.	75

GEOLOGIC SECTIONS ACROSS THE EVERGLADES OF FLORIDA.

E. H. SELLARDS.

The Everglades of Florida include an area extending from Lake Okeechobee nearly to the southern end of the Florida Peninsula, and from within a few miles of the Atlantic coast to the head waters of the Caloosahatchee River, or approximately 90 miles north and south and 45 or 50 miles east and west. Although the borders are somewhat indefinite, particularly to the south and southwest, the Everglades include in all 4,000 or 5,000 square miles. The greater part of this area is covered with an accumulation of muck or peat to a depth of several feet, and with the exception of occasional wooded islands supports a dense growth of saw grass (*Cladium effusum*). The muck being soft and partly submerged, and the grass not easily penetrated, travel through the Everglades has heretofore been difficult. Moreover, on account of the presence of this muck there was almost no opportunity to examine the underlying formation, and such geological observations as were made previous to the drainage operations in this section, were confined largely to the borders, the interior being practically unknown to the geologist. At the present time, however, owing to the extensive excavations that have been made by the State of Florida in connection with the drainage operations, this area is not only accessible, but affords exceptionally favorable opportunity for geologic studies. The canals now extend directly across the area forming a complete section in which the formations may be seen, either in place along the canal, or as thrown out on the bank by the dredge. The deposits are highly fossiliferous and afford a new and extremely interesting collecting ground. Moreover, owing to the lowering of the water, the rock forming the basin of Lake Okeechobee now projects above water in one or two places, thus affording the first opportunity of examining the substructure of this large area of

over 700 square miles which heretofore has been concealed by the waters of this lake.*

The geologic section which is here described extends from the Gulf of Mexico to the Atlantic Ocean. The line of the section follows the Caloosahatchee River to Fort Thompson, 50 miles; thence through the canals and small lakes in a general easterly direction to Lake Okeechobee about 25 miles. From Lake Okeechobee the section follows the North New River Canal in a south easterly direction to New River, 57 miles; thence to the Atlantic Ocean about 8 miles; or a total distance from the Gulf to the Atlantic of 135 miles. The oldest formations found in this section lie at the west or Gulf side, while the newer formations lie on the east, and hence as a matter of convenience the section will be described from west to east. Large collections of fossils, as well as lithologic samples of the formations were made which are available for subsequent study. In making the examination of the exposures along the canals and in Lake Okeechobee a small launch was used, placed at the writer's disposal for that purpose through the courtesy of the State Drainage Commission.

THE SUB-STRUCTURE OF THE EVERGLADES.

The Eocene limestones which are extensively exposed north and west of the Everglades underlie that area although they are not seen at the surface. At Fort Meade, about 100 miles northwest of Lake Okeechobee, limestones as shown by well drillings, lie at a depth of 410 feet from the surface while on the Atlantic Coast, similar limestones as shown by well records at Palm Beach lie not less than 900 feet from the surface, indicating, a general eastward dip, although possibly with local variations. At Key West about 100 miles southwest of the southern border of the Everglades, this limestone lies at a depth of about 700 feet from

*The area of Lake Okeechobee at stage of water 20 feet above sea, is 730 square miles, at 16 feet, 710 square miles. Report of Florida Everglades Commission, p. 10, 1913, Senate Document No. 379. With the exception of Lake Michigan it is thus the largest fresh water lake lying wholly within the United States.

the surface.* This data is consistent with other data available indicating a general south and east dip of the formations. The Oligocene and Miocene formations are somewhat difficult to recognize in well samples, but the fact that these formations lie at the surface along the Gulf coast as far south as Polk and Manatee counties, and are also believed to be represented in the wells on the Atlantic coast, leads to the reasonable conclusion that they also underlie the Everglades although at a considerable depth. The depth at which these formations are to be expected is a matter of importance to the agricultural and industrial development of the Everglades country, since the limestones include the principal water bearing strata of the State, and supply the greater part of the artesian water of peninsula Florida.

At Palm Beach on the east coast Miocene deposits are believed to have been recognized at a depth of 400 feet, while in a well at Knights Key the Miocene appeared to be present at from about 180 to 420 feet.* From its known distribution on the Atlantic coast it seems probable that the Miocene underlies the Everglades resting upon the Eocene or Oligocene. In this connection also it should be noted that the Miocene has been somewhat doubtfully identified as occurring near Caloosa, on the Caloosahatchee River west of the Everglades.†

SURFACE FORMATIONS OF THE EVERGLADES.

CALOOSAHATCHEE MARL

With the possible exception of the Miocene exposure near Caloosa, the oldest deposits in the section here described are the Pliocene deposits known as the Caloosahatchee marl, the surface outcrop of which is found along the Caloosahatchee River and hence west of the Everglades. This formation, being readily accessible, has long been known to geologists and has been fully described in earlier papers.†† Angelo Heilprin, who in company

*Fla. State Geol. Sur. Second Annual Report, pp. 204-206, 1909.

†Fla. Geol. Survey, Sec. Ann. Rept., p. 122, 1909.

††Heilprin, Wagner Free Inst., Vol. 1, p. 32, 1887. Dall Wm. H. U. S. Geol. Bull. 84, p. 147, 1892. Matson and Clapp, Fla. State Geol. Surv. Second Annual Report, p. 126, 1909.

with Joseph Willcox, visited this locality in 1886, refers to this formation as follows.* “This is without question the most remarkable fossiliferous deposit that has as yet been discovered in the State, and from a purely paleontological standpoint, perhaps, the most significant in the entire United States east of the Mississippi River. The fossils, which are about equally distributed between both banks, crop out in almost countless numbers, and attract attention, apart from their prodigious development, by their great variety, large size, and beautiful state of preservation. The whole bank much resembles a fossil shell-beach, and recalled to my mind the wall of shells extending from Little Sarasota Inlet to Casey’s Pass.” At Fort Thompson this marl passes beneath later formations from which it is separated by a well marked unconformity which is best seen in the exposures along the river between Labelle and Fort Thompson. The following section is seen at a cut-off between two bends in the river about one-half mile below Fort Thompson. The section as given here was made by the writer in 1908.

SECTION ONE-HALF MILE BELOW FORT THOMPSON.

8. Sand and soil at top of bank about 2 feet.
7. Shell marl in which *Chione cancellata* predominates 2 feet.
6. Shell marl in which fresh water gastropods predominate 2 feet.
5. Shell marl, marine shells $\frac{1}{2}$ foot.
4. Unconformity.
3. Calcareous stratum weathering rough on exposure containing Pliocene fossils 3 feet.
2. Shell marl with Pliocene fossils 1 foot.
1. Blue sandy clay marl with few fossils to the waters edge 3 feet.

An examination of the banks above and below this locality shows that while the details of the section vary, the unconformity is persistent and is well marked. As illustrating local variation it may be noted that a few rods down stream from the point from which this section was made, the marine shell (No. 5) is lacking, the fresh water marl being the first member above the unconformity, while about one-fourth mile down stream clay lenses as

*Trans. Wagner Free Inst. Sci., Vol. 1, p. 28, 1887.

much as two feet in thickness, containing broken vertebrate remains fill in the irregularities at the top surface of the Caloosahatchee marl. Just above Labelle the shell marl (No. 2) is absent, the calcareous stratum resting upon the blue sandy clay marl. The unconformity, however, is plainly seen being indicated at this locality by well worn rock fragments.

The extension of the Caloosahatchee marls to the northeast has been shown by collections made by Mr. H. G. Hayes from the banks of the St. Lucie Canal northeast of Lake Okeechobee.

FORT THOMPSON BEDS.

While the deposits lying above the Caloosahatchee Marl in the vicinity of Labelle and Fort Thompson have been referred to by several writers they have not previously been described in detail owing, perhaps, to imperfect exposures. The excavations that have now been made, however, afford the opportunity of examining these deposits at several localities between Fort Thompson and Lake Okeechobee, as well as in the Everglades. The following section of these deposits is found just below Goodno's Landing, Fort Thompson.

3. Fresh water limestone 2 feet.
2. Marine shell marl $\frac{1}{2}$ foot.
1. Fresh water shell marl 3 feet.

The Caloosahatchee marl, as may be seen by continuing the section down stream, either lies immediately below the fresh water shell marl, No. 1, of the section, or is separated from that marl by a marine shell marl. By continuing the section up stream it is found that a marine shell marl rests upon the fresh water limestone, and that this in turn gives place to a fresh water marl.

To these deposits consisting of alternating fresh and brackish water and marine marls and limestones is here applied the term, the Fort Thompson Beds, the type exposure of which is at Fort Thompson.

The fresh water limestone of this formation was referred by

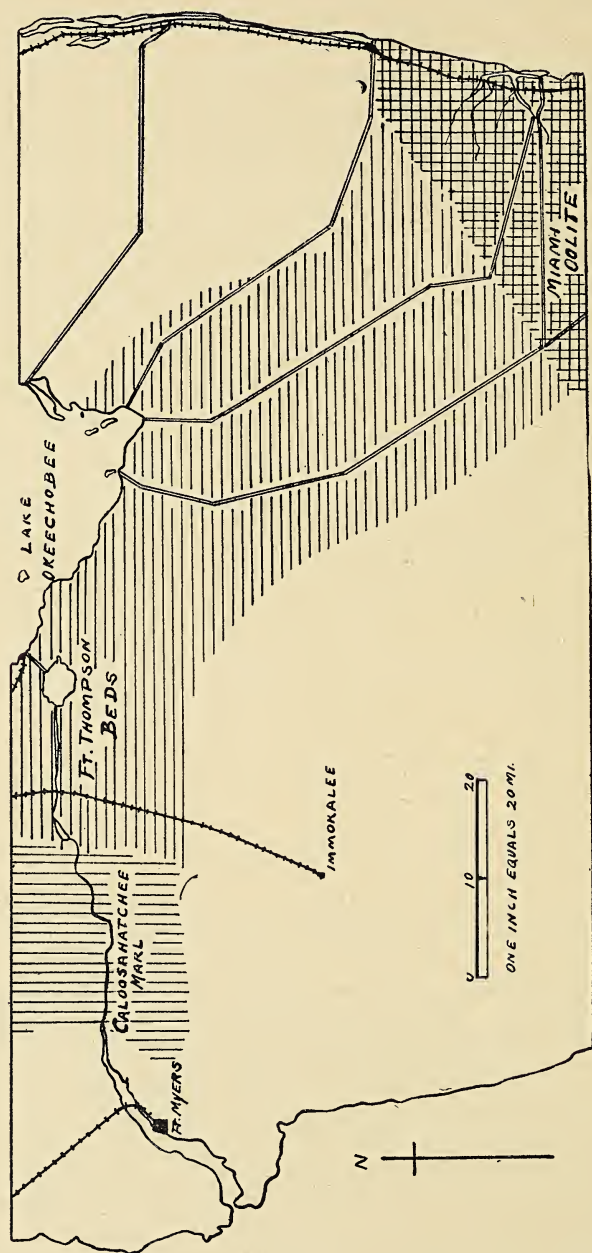


Fig. 1. Sketch map illustrating geologic section across the Everglades.

Heilprin to the post-Pliocene*. Of the fossils Heilprin says "All the molluscan forms occurring in the limestone are identical with the species now living in the river". Dall writing in 1887 agrees with Heilprin in referring the limestone to the Quarternary,† but in a subsequent paper †† expresses the view that this is Pliocene, stating that the *Planorbis* rock "contains only extinct species or recent species also common to the Pliocene marl." The shell marl above the *Planorbis* rock was, however, still referred by Dall to the Quaternary. Dall has not given a list of the fossils on which the reference of these beds to the Pliocene is based, the few forms mentioned by him, including *Planorbis Physa* and *Chione cancellata*, are either long range forms, or being only generically determined, lack stratigraphic value. By far the most abrupt break in this section both in lithology and in fauna is that occurring at the unconformity that has been described which clearly marks the top surface of the Caloosahatchee marl, and unless the fossils above the unconformity are shown conclusively to be Pliocene, it is natural to assume that this stratigraphic break marks the dividing line in this section between the Pliocene and the Pleistocene.

COFFEE MILL HAMMOCK MARL.

Lying upon the fresh water limestone, No. 3 of the preceding section, is a shell marl, the maximum observed thickness of which is about two feet. Although removed by erosion at the rapids this marl is very persistent. It is seen in place at Goodno's Landing, Fort Thompson, and at Coffee Mill Hammock, twelve miles above Labelle. The predominating fossil is *Chione cancellata*, shells of which have been thrown out in great profusion by the dredge.

LAKE FLIRT MARL.

The Coffee Mill Hammock shell marl is succeeded by a marl which is strikingly different both in lithologic appearance and in the fossils which it contains. The marl consists of a calcareous

*L. C. p. 32

†Amer. Jour. Sci. (3) Vol. 34, p. 169, 1887.

††U. S. Geol. Sur. Bull. 84, p. 144, 1892.

mud in which the fresh water shells chiefly gastropods are imbedded. This stratum has a thickness of three or four feet and is best seen underlying the basin of Lake Flirt from Old Fort Thompson to Coffee Mill Hammock, a distance of about eight miles. This marl is of fresh water origin, and may be quite recent in age.

LIMESTONES IN LAKE OKEECHOBEE

Within Lake Okeechobee there is apparently a reef of rock extending in a general northwest-southeast direction between Observation and Rita islands. At a point about 5 miles southeast of Observation Island the rock of this reef now stands above water at intervals for a mile or so, the maximum exposure at the present low water stage being about two feet. At the surface this limestone is quite hard, or is streaked in a characteristic manner with alternate hard and soft layers. Beneath the surface, however the rock is a rather soft oolitic marl or limestone of granular texture and light yellow color. The hard phase of this limestone is much like the limestone found in the canal three miles west of Lake Hicpochee, while a thin stratum of a similar limestone is found near the surface at Coffee Mill Hammock. A few pieces of the marl phase of this limestone seem also to have been brought up from the lake at the entrance of the north New River canal.

From the canals leading out of Lake Okeechobee to the south and southeast for a distance of about 25 miles very little rock has as yet been removed. Such fragments as are seen along the canals, however, represent very hard compact fresh-water limestones. On the North New River canal dredging of the heavy limestone begins about 26 miles from Lake Okeechobee. The rock cut through on this part of the canal consists of a very hard compact close-grained limestone which breaks with a sharp fracture and will evidently make valuable concrete material. The same limestone is cut into on the south canal at 24 miles from the Lake. The very hard phase of this rock is a fresh-water limestone. As found on the banks of the canal, however, marine and fresh water limestones and marls are intermixed, indicating that there, as elsewhere, the formation includes alternating fresh water and marine deposits. Pieces of this fresh water limestone are found on the North River canal as far as 42 miles from the Lake, although for the last three

or four miles of this distance the heavy limestone stratum gives place largely to marls. It seems very probable that the deposits cut through in this part of the Everglades represents the eastward extent of the Fort Thompson Limestone with its associated fresh water and marine shell marls.

MIAMI FORMATIONS.

Another limestone seen on the North New River Canal is cut into by the dredge at a distance of about 42 miles from Lake Okeechobee. This limestone is granular and is more or less distinctly oolitic in structure and is not so hard as that seen nearer the lake. The surface of this rock becomes very rough on exposure presenting a characteristic matted appearance. This rock is seen in the canal to within 9 miles of Fort Lauderdale (52 miles from Lake Okeechobee). Until its extent and thickness are more definitely known, this limestone is, perhaps, best regarded as a member of the Miami formation, the typical representative of which, is the Miami oolitic limestone which is found at the surface in the vicinity of Miami.

The typical Miami oolitic limestone is first seen in this canal about 6 miles from Fort Lauderdale (55 miles from Lake Okeechobee). For about 3 miles above this point no rock is found in the canal banks, only sand being reached by the dredge. The absence of rock from this part of the section indicates clearly that a sand stratum some feet in thickness intervenes between the limestone described in the last paragraph and the typical Miami oolite. From its first appearance in the canal the Miami oolite is continuous to the coast forming the country rock in this part of the section.

The relation of the Fort Thompson beds to the Miami Oolitic limestone was not determined owing to the lack of continuous exposures. The succession of deposits indicates alternating fresh water and marine conditions, but whether these conditions prevailed in this area previous to the deposition of the Miami oolite or subsequent to that time can be determined only by more detailed stratigraphic and paleontologic studies than have been made in this area.

STRUCTURAL CONDITIONS.

The formation in southern Florida west of the Everglades deviate somewhat from their original position by slight folding of the strata and by tilting of the land area. The minor folds of the Caloosahatchee formation have long been observed and frequently described. The folds in this formation are small and numerous. Their general direction is north to south or northwest to southeast. The Fort Thompson formation also presents minor folds, although less numerous, perhaps, than the Caloosahatchee formation. This is well seen in the banks of the canal crossing Lake Flirt. The limestone which stands as much as 5 feet above water level at the rapids passes below water level one or two miles above the rapids. This limestone, however, comes to the surface again at Coffee Mill Hammock about 8 miles east of Fort Thompson.

THE COFFEE MILL HAMMOCK ANTICLINE.

The ridge of rock cut through by the canal at Coffee Mill Hammock represents a small anticline which has a general north-south direction, and may be traced by the outcropping of rock at the surface for some miles. Lake Flirt occupies the shallow trough between this anticline and the Fort Thompson rock exposure which probably also represents a small anticline.

In the Everglades southeast of Lake Okeechobee along the North New River canal no evidence of folds are found, the rock lying horizontal or nearly so for a north-south distance of forty miles. Approaching the east border of the Everglades, however, particularly in that part of the canal which has a due east course, evidence of dip of the formations to the east is apparent. A general east dip is further indicated by the fact that flowing artesian wells are obtained at a comparatively shallow depth at Fort Lauderdale and at Miami on the Atlantic coast.

THE AGE OF THE UNDERLYING ROCKS OF FLORIDA AS SHOWN BY THE FORAMINIFERA OF WELL BORINGS.

JOSEPH A. CUSHMAN.

After the discovery of foraminifera indicating older formations than had hitherto been found in Florida in well borings sent to me through the U. S. Geological Survey* the State Geologist, Dr. E. H. Sellards, asked me to undertake a study of various well borings. It was hoped that a study of the foraminifera of these samples from different parts of the State would reveal the presence of beds of definite age and add to our knowledge of the geologic structure of the Florida peninsula.

In all there were submitted to me well samples from fifteen localities widely scattered over the State. While these localities represent a very small amount of data compared to the areal extent of Florida, they are so located that taken together they give a skeleton on which may later be built up a detailed geologic structure. The data for the various wells will be given and then they will be followed by a general interpretation of what the foraminifera have to show as to the age of the various rocks penetrated. First however a few cautions as to the use of well samples may not be out of place.

SPECIAL FIELD OF THE FORAMINIFERA.

In the process of well drilling the larger fossils are often ground into fragments too small to be of any value for specific determinations and therefore for determining definitely the age of the rocks penetrated. Of other groups likely to escape breakage the bryozoa and foraminifera are probably the only two found in quantity. Although ostracoda often escape damage by the drill they are not usually in great enough numbers in enough various horizons to be equal in value to the other two. Of the two groups

*This material from the Bushnell well was sent me by the Florida Survey through the U. S. Geological Survey.

the bryozoa are much less liable to escape breakage. Many of the foraminifera are but a millimeter in diameter and enough of these remain intact so that most beds containing any number will give some identifiable specimens. The exception to this is the case of hard limestones where often the specimens do not become loosened and the whole may be ground into a mass containing nothing of value for determinations.

On the whole then the foraminifera are by far the best group for use in the study of well samples, from their small size, thus more often appearing in recognizable form and their relative abundance in so many of the members of all the formations of the Coastal Plain from the Lower Cretaceous to the Pleistocene.

There are however barren stretches in all formations where not even foraminifera occur, especially the shore sands of various ages and chemically deposited limestones like the oolitic formations. In addition to these the conditions of preservation may affect their usefulness. In certain beds greensands appear made up of the internal glauconitic casts of abundant foraminifera but not enough of the external characters remain for use in determination. Similarly in the older formations the changes made have left casts of silica or calcite which cannot be specifically determined.

Also in the case of those beds which have abundant foraminifera, enough is not yet known in regard to the foraminiferal faunas of various horizons to give a basis for close comparisons. This lack of information in regard to the Coastal Plain region is, however, being rapidly overcome and much unpublished data from my own work has been available for the present determinations.

Another difficulty, especially in the case of southern Florida, is that the formations were deposited under different ecological conditions from those of northern Florida and adjacent states where the faunas are best known. As will be shown later, the formations of the Oligocene and older formations represented in the wells of the extreme southern part of Florida are not to be closely correlated with formations of our southern states but with tropical America, the West Indies and Central America. Detailed work in those areas is as yet hardly begun, but the comparisons as far as they can be made, indicate that close correlations are possible.

SOURCES OF ERROR.

In the process of drilling a well unless a casing is put in as drilling proceeds there is great chance of error by material falling down from levels above that at which drilling is actually taking place. Thus there is a great source of possible error, and this will show itself by giving too great thickness to a bed from this reason. On the other hand, the drill may penetrate a formation some distance before recognizable fossils are discovered and the range of the formation placed too low. A check in both of these sources of error is the fact that no fossils can appear in the samples until the bed containing them is reached.

In the case of Florida and the Coastal Plain in general, wells penetrate the same formation but once as these rocks are not greatly folded or faulted. Therefore, when fossils of a younger formation keep reappearing after an older formation is penetrated, it is very safe to assume that they came from the upper levels and do not belong with the older formations. Such specimens in the case of larger species are apt to become of larger size and more perfect when they fall from the walls above than were the specimens from the same formation at the time the drill was penetrating that particular bed. This is especially true of the larger nummulites and orbitoids of the Oligocene and upper Eocene.

On the whole, with these various sources of error constantly in mind it is safe to assume that very accurate and reliable knowledge may be obtained from the careful study of well samples.

DATA FROM THE WELL SAMPLES.

The location of the fifteen areas from which well samples were studied from northwestern Florida to the Keys is as follows, the location being plotted in the accompanying map:

1. Panama City, Washington County, 470 feet.
2. Bonheur Development Co., near Burns Station, Waukulla County, 2,153 feet.
3. Jacksonville, Duval County, 980 feet.
4. St. Augustine, St. Johns County, 1,440 feet.
5. Anthony, Marion County, samples 50-500 feet.

6. Eustis, Lake County, samples from 100-180 feet.
7. Bushnell, Sumter County, samples from 380-3,080 feet.
8. Apopka, Orange County, samples from 50-390 feet.
9. Sanford, Seminole County, samples from 95-113 feet.
10. Cocoa, Brevard County, a sample from 190 feet.
11. Tiger Bay, Polk County, 770 feet.
12. Okeechobee, Okeechobee County, samples to 500 feet.
13. Boca Grande, Lee County.
14. Fort Myers, Lee County, 950 feet.
15. Marathon, Monroe County, 2,300 feet.

The well at Boca Grande was represented by a single sample that gives no definite information and is not further considered. Of the others, some are represented by but very few samples, others by samples of indefinite range, and others by very full detailed specimens. Thus the relative value is very different and each is considered separately. For convenience of reference the information is given in the order as indicated above. A brief summary of the probable stratigraphy is given with each well and the whole summarized in a general account later.

I wish to express my thanks to Drs. T. Wayland Vaughan, T. W. Stanton and C. W. Cooke for reading parts of the present paper and for helpful suggestions. Also I wish to thank the State Geologist, Dr. E. H. Sellards, for his interest in the work and his courtesy in obtaining needed information.

WELL AT PANAMA CITY, FLORIDA.

Depth of well 470 feet. Samples are few and represent wide ranges and therefore are very unsatisfactory for detailed work.

- 30-60 feet. No foraminifera.
- 60-100 feet. Foraminifera very rare and poor.
- 100-200 feet. Foraminifera very rare and poor.
- 200-300 feet. Foraminifera small, numerous.
- 300-400 feet. Foraminifera few and poor.
- 400-470 feet. Represented by a single large specimen with casts of mollusca and *Nummulites* (?) indicating Eocene.

There is little use in trying to determine the stratigraphy from such poor data. There is a specimen of white hard material

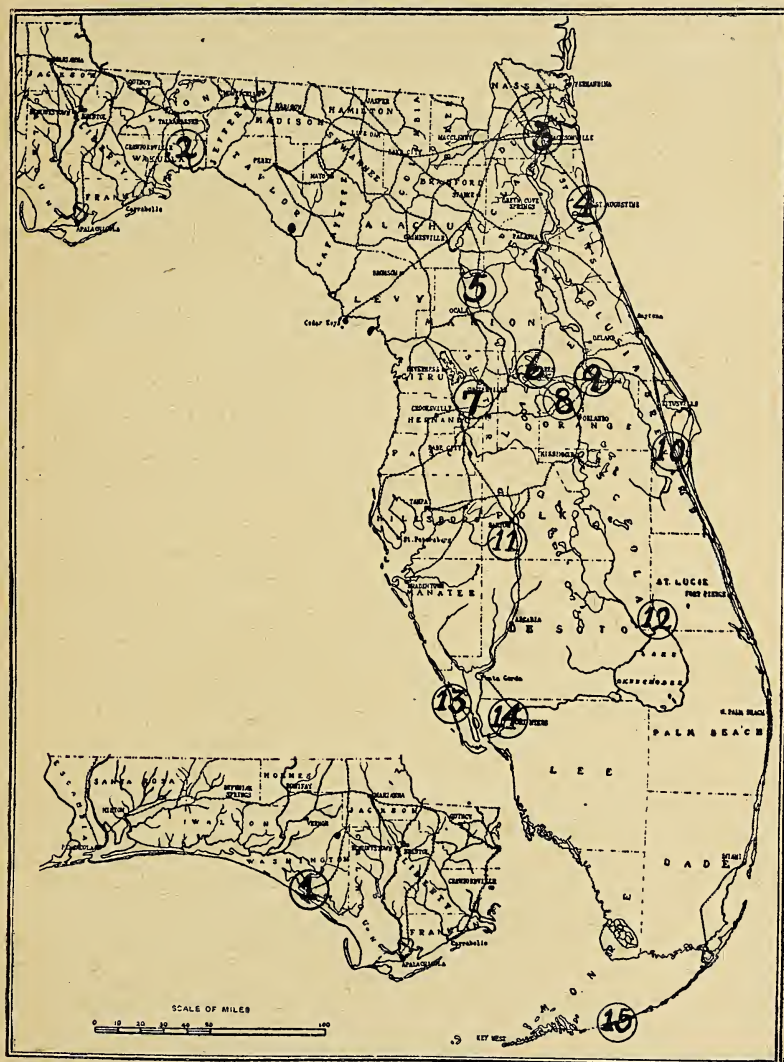


Fig. 2. Sketch map of Florida showing locations of wells. Wells numbered as in the text.

marked "300 feet up" in which *Orbitolites* occurs and may represent the Tampa formation of the upper Oligocene. Some of the smaller foraminifera of the sample marked "200-300 feet" resemble those of the Cooper Marl and similar age, while the rock specimen with a possible fragmentary cast of *Nummulites* (?) may represent upper Eocene also. With the lack of definite data little reliability should be placed upon the evidence.

WELL OF BONHEUR DEVELOPMENT COMPANY,
BURNS, WAKULLA COUNTY, FLORIDA.

Depth of well 2,153 feet. Well begun as a 14-inch hole; three lines of casing put down; first casing 12 inches; second casing 8 inches to 700 feet; third, 5 inches to 1,502 feet.

The well starts in limestone of the Chattahoochee formation. Samples show the following results although there is evidence of mixing of material from above in spite of the casing which may not have been inserted as fast as drilling:

- 50 feet. *Lepidocyclus* fragments with suggestions of *Operculina* and *Gypsina*.
- 100 feet. A single crystalline fragment of a bit of the equatorial band of chambers of a *Lepidocyclus*.
- 150 feet. Fragments of *Lepidocyclus*, *Operculina*, *Nummulites* and *Gypsina*.
- 180 feet. Numerous, compressed, rounded, complex foraminifera but water-worn and changed to calcite showing little structure. Also casts of a *Rotalia* with an angled contour.
- 250 feet. Fragments of foraminifera of same forms as noted in various layers above.
- 325 feet. Conical *Orbitolina* with other Lower Cretaceous forms with a few *Rotalia* from above, like those at 180 feet.
- 400 feet. Hard limestone. Little in the way of foraminifera, except small fragments.
- 580 feet. Numerous conical *Orbitolina* but perhaps of different species from those at 325 feet.
- 700 feet. *Lepidocyclus*, *Nummulites*, *Gypsina*, etc., all well preserved and evidently from near the top of the well.
- 920 feet. A single *Orbitolina* fragment.
- 940 feet. Numerous well preserved *Nummulites*, white with iron rust spots and a few crystallized specimens of *Orbitolina*. Both evidently from different layers higher up in the well.

- 950 feet. Similar, the *Nummulites* large, white except for rust spots and nearly whole. Certainly from near the top of the well.
- 980 feet. Similar to preceding.
- 1000 feet. Fragments of *Nummulites*, *Lepidocyclina*, *Operculina* with occasional conical *Orbitolina*. A mixture from higher levels.
- 1050 feet. Similar, mostly *Nummulites* and *Orbitolina*.
- 1135 feet. Similar but fragments of *Operculina* and *Lepidocyclina* in addition.
- 1150 feet. Similar to preceding.
- 1322 feet. Few foraminifera, not distinctive. *Cristellaria* added.
- 1400 feet. Similar but with fragments from higher levels.
- 1450 feet. A few fragmentary poorly preserved forms.
- 1500 feet. Light colored chalky material, occasional foraminifera, *Cristellaria*, etc., *Orbitolina* from above.
- 1559-1661 feet. Similar but with flinty chips at 1600 feet with large rusty iron flakes as though casing has been put down at this point or new drilling started.
- 1700-1800 feet. Light colored crystalline limestone with a few casts of foraminifera.
- 1800-1900 feet. Similar material with bluish fragments similar to some seen at 1450 feet, probably from above.
- 1900-1922 feet. Similar.
- 1922 feet. Mostly rusted iron flakes from casing.
- 1925-1993 feet. Similar to 1900 feet.
- 1995 feet. Hard compact crystalline limestone. No foraminifera.
- 2000-2100 feet. No indentifiable foraminifera.
- 2135-2153 feet. Peculiar fibrous oily material with light colored material from above.

PROBABLE STRATIGRAPHY.

The intervals between the samples is rather wide and consequently detailed information is impossible.

The material at 50 feet suggests that the Chattahoochee has already been wholly penetrated and the Ocala reached. At 150 feet fragments of *Nummulites* appear and whole specimens at various depths below showing that the Eocene Nummulitic horizons appear somewhere below the Ocala, probably somewhere between the 150 and 50-foot levels.

At 180 feet the peculiar foraminifera are unfortunately crystallized with a loss of structure so the age cannot be determined. They indicate shallow water as they are clearly worn and rounded by water action.

At 325 feet the conical *Orbitolinae* indicate the Fredericksburg Series of the Lower Cretaceous as occurring at or somewhere above this level.

The 400-foot level is in the same hard limestone that occurs below the conical *Orbitolina* in other wells of Florida.

At 580 feet the large numbers of conical *Orbitolina* may indicate another bed of the Fredericksburg Series or the specimens may have come from the upper layer.

Below this level the Foraminifera are rare and usually represented by casts except those that have fallen from higher levels. No sign of the large, low forms of *Orbitolina* is found, although most of the material is finely ground by the drill and the samples are at comparatively wide intervals. The entire thickness below 325 feet may be all Lower Cretaceous and certainly cannot be younger.

NEW CITY WELL AT JACKSONVILLE, DUVAL COUNTY, FLORIDA.

A description of the samples from this well has already been published (Florida Geological Survey, Fifth Annual Report, 1913, pp. 177, 178). Depth of well 980 feet. Casing was put in to 500 feet.

- 0-510 feet. Throughout this distance the samples show no foraminifera.
- 510-550 feet. *Lepidocyclina* occurs but only in poor fragmentary specimens.
- 550-780 feet. Finely broken material with broken specimens of *Lepidocyclina*, *Operculina*, *Nummulites*, and *Gypsina* occurring apparently in a mixed condition.
- 820-845 feet. *Orbitolina* of the conical form occurs.
- 845-900 feet. *Orbitolina* as above but in both cases with scattered fragments from the upper layers.
- 900-980 feet. *Orbitolina* of the large, low, concave form with the smaller conical form from above.

PROBABLE STRATIGRAPHY.

The upper portion without foraminifera must depend on other data for solution of its age. The upper portion has been recorded

as Pleistocene with possibly some Pliocene, while at about 33 feet the Miocene begins and continues to a depth of at least 496 feet as given by older records.

At 510-550 feet is either Oligocene or the Upper Ocala indicated by the *Lepidocyclina* fragments and those of *Operculina*. These occur more frequently here and suggest that if, as is probable, they are from the Upper Ocala, this formation has somewhere near its usual forty feet of thickness at this point. The other scattered fragments below probably originated at this level.

Below 550 feet specimens of *Nummulites* occur, indicating an Eocene horizon below the Ocala as noted elsewhere.

No definite new things appear until at 820-845 feet, where *Orbitolina* of the conical form appears, indicating that somewhere in this range the Lower Cretaceous of the Fredericksburg is entered. This is more clearly defined between 845 and 900 feet.

Somewhere between 900 and 980 feet the large, low forms of *Orbitolina* appear, indicating that a lower portion of the Fredericksburg appears or more likely that beds of the Trinity group are entered.

PONCE DE LEON WELL AT ST. AUGUSTINE, ST. JOHNS COUNTY, FLORIDA.

The description of the samples from this well is given earlier (Florida Geological Survey, Fifth Annual Report, 1913, pp. 195, 196). Depth of well 1,440 feet. Depth of casing unknown but probably not great.

As sent me, the samples cover but a few points in the depth drilled but show certain significant facts:

160-200 feet. Few foraminifera, but Miocene indicated.

440 feet. Numerous conical *Orbitolina*.

785, 830, 1051 feet. All show the same *Orbitolina*.

PROBABLE STRATIGRAPHY.

Although there are no samples between 200 and 440 feet, the Ocala must occur in this range as two fragments of *Lepidocyclina* were found in the sample from 995 feet evidently originating far above. According to determinations by Dr. W. H. Dall (U. S.

Geol. Surv. Bull. 84, p. 125, 1892) fossils of Vicksburg age [probably Upper Ocala] were observed at St. Augustine at a depth of 224 feet. This would fit into the gap in the samples I have had and would account for the *Lepidocyclina* already noted. This also coincides with the data from other adjacent areas.

There is no record of whether a horizon characterized by abundant thick *Nummulites* occurs here or not.

The Lower Cretaceous of Fredericksburg age is indicated by the sample from 440 feet and occurs below, but probably originated from about the same general level. How much above 440 feet the Lower Cretaceous extends cannot be determined, from lack of material.

According to the description of the samples, a dense, light brown limestone is encountered from 495-520 feet. This may be similar to the hard, brown limestone occurring below the conical *Orbitolina* at various places.

In the very limited material from below, none of the large, low forms of *Orbitolina* were met with but are in all probability there. Fossiliferous limestones are recorded in the descriptions from 1,293-1,390 feet but no samples from this range were available except at 1,351 feet, which had nothing of value.

The well records show that both the Ocala and the Lower Cretaceous are much nearer the surface here than at Jacksonville.

WELL OF CAMPAGNIE GENERALE DES PHOS. DE LA FLORIDE, AT ANTHONY, MARION COUNTY, FLORIDA.

Samples are available from depths between 50 and 500 feet. No records of the casing are available, but from the condition of the samples it must be very complete for at least the upper portion. Samples examined show the following:

- 50 feet. No *Lepidocyclina* but very abundant large *Nummulites*.
- 75 feet. Few *Nummulites*.
- 100 feet. Few *Nummulites*.
- 110 feet. Numerous small foraminifera—*Miliolidae* and *Orbitolina*.
- 130 feet. Mostly hard rock fragments. No foraminifera.

- 160 feet. Numerous *Orbitolina*, arenaceous *Bulimina*, etc.
200 feet. Abundant *Orbitolina* and like 160 feet.
260-500 feet. Hard brownish rock without identifiable foraminifera.

PROBABLE STRATIGRAPHY.

As this well is known to start in the Ocala limestone, that formation with any surface overburden must have a total thickness of less than fifty feet. The horizon represented by large *Nummulites* at 50 feet is Eocene similar to that noted at other wells and coming in below the Ocala. The samples from 75 and 100 feet have a few of these *Nummulites* which have probably been carried down from the 50-foot level. At 110 feet the Lower Cretaceous is entered and apparently continues to at least 200 feet, below which from 260-500 feet is a hard, brownish limestone seen in other wells, and represents the Fredericksburg or older formations of the Lower Cretaceous.

The Upper Eocene from the records seems to rest upon the Lower Cretaceous as in other areas.

This is an especially important link in the evidence as confirming the suspicion noted in the discussion of the Tiger Bay well that the Ocala there is really only represented by the forty feet of strata above the abundantly occurring *Nummulites* and that the material apparently coming below of Ocala age really was derived from above. It would indicate that the Ocala limestone represented typically by the *Lepidocyclina* limestone about Ocala is usually but about 40 feet in thickness over a wide area and has not the great thickness that has been assigned to it.

WELL OF J. WIGGINS AT EUSTIS, LAKE COUNTY,
FLORIDA.

Depth 180 feet, depth of casing not recorded, samples from 100 to 180 feet.

The samples from 100, 109, 115 and 120 feet show no foraminifera.

- 138 feet. Foraminifera are numerous, mainly *Miliolidae* with some large *Rotaliidae*.

- 160 feet. Similar foraminifera, but with occasional specimens of *Orbitolina* of the high conical form.
- 170 feet. Similar with occasional large *Nummulites*.
- 180 feet. Similar but without *Nummulites*.

PROBABLE STRATIGRAPHY.

As the upper 120 feet is not represented by samples, nothing definite can be given except that the occurrence of the large *Nummulites* at 170 feet is a clear indication that they came originally from somewhere above 138 feet. Above the nummulite horizon may be the Upper Ocala, but there are no traces of *Lepidocyclus* in any of the samples, so if the Ocala had been penetrated it must have been securely cased in and all the material removed before any of the samples below 100 feet were taken. The thickness of the Ocala, if it occurred, cannot have been very great.

The occurrence of *Orbitolina* and the group of smaller foraminifera characteristic of the Apopka well at levels of 115 feet show the slightly lower level of the Lower Cretaceous than further south.

WELL OF DUNDEE PETROLEUM COMPANY AT BUSHNELL, SUMTER COUNTY, FLORIDA.

Depth of well 3,080 feet. Depth of casing not recorded. Samples begin at 380-foot level.

Although the samples of this well represent every five or ten feet of the borings they are as a whole very disappointing in the information they give. From 380 to 500 feet the samples show a hard, granular limestone apparently equivalent to that from 260-500 feet in the well at Anthony. If this is the case, the Ocala and *Orbitolina* horizons of the Lower Cretaceous had already been penetrated before the 380-foot level where samples are available.

- 500-664 feet. Mostly hard, brownish limestone with no foraminifera.
- 684-867 feet. Granular limestone with variable amounts of dark flint chips. No foraminifera.
- 890 feet. Same material with a fragment of *Orbitolina*.
- 900-1008 feet. Same material. No foraminifera.
- 1027 feet. Same material. Cast of foraminifera.

- 1281 feet. Large *Rotaliidae*, no *Orbitolina*, a brachiopod present.
1305 and 1334 feet. Similar.
1421 feet. Calcite crystals and white limestone. A few foraminifera.
1450 feet. White limestone and flinty chips. A few *Rotaliidae*.
1490 feet. Fine, sandy. No foraminifera.
1495-1575 feet. White or bluish limestone. *Orbitolina*.
1620-2250 feet. Compact limestone. Few poorly preserved foraminifera.
2250-3080 feet. Hard, grey or whitish limestones, occasionally with peculiar foraminiferal casts, appearing at various levels, evidently having been derived from around 2500 feet, where it is common.

PROBABLE STRATIGRAPHY.

As already noted, the upper 380 feet which is not represented by samples, probably has the same sequence as in the wells in the same general region—that is, Ocala, at slight depth or wanting, then a Nummulite Eocene horizon, below which would come the *Orbitolina* horizon of the lower Cretaceous, Fredericksburg Series. Below this, at Anthony, is the hard, brownish limestone and it is in this series that the samples at Bushnell begin at 380 feet. At a little over 1,000 feet and perhaps much higher are the large, concave *Orbitolina* forms characteristic of the Trinity group of the Lower Cretaceous. The series for a considerable distance, perhaps throughout, is Lower Cretaceous although peculiar forms in the deepest thousand feet and especially beyond 2,500 feet may belong to other older series.

CITY WELLS AT APOPKA, ORANGE COUNTY,
FLORIDA.

Total depth represented by samples, 390 feet, depth of casing 117 feet.

The upper 114 feet of the well is represented by samples at the following depths: 50, 60, 103, 104, 106 and 114 feet. No foraminifera were found in any of these samples.

At 115 feet foraminifera begin to appear, the most common being the high forms of *Orbitolina*. Specimens of *Orbitolina* occur also at 145, 250, 310, 330, 380 and 390 feet showing that either they have come from between that depth and 115 feet or are found

at the level at which drilling was proceeding at that time. Other forms of foraminifera occur with the *Orbitolina*, but none which stratigraphically could not have occurred with it. At 230, 240 and 250 feet *Miliolidae* are frequent but are of types which may be of the same age as the *Orbitolina*. At 390 feet *Tritaxia* occurs with *Orbitolina* but as this genus is very characteristic of the Cretaceous and found in the Lower Cretaceous it affirms the age of the *Orbitolina*.

PROBABLE STRATIGRAPHY.

The most striking fact of the upper part of the well is the apparent absence of *Lepidocyclina* limestone referable to either the Ocala or Vicksburg. In fact the genus *Lepidocyclina* is absent from the samples.

All the data from the samples at 115 feet and below indicate Comanchean Lower Cretaceous of the Fredericksburg group.

The whole data would seem to indicate that the Lower Cretaceous strata here come to within 115 feet of the surface and that they are directly overlain by strata probably of Miocene age. This may indicate that the Ocala was eroded from this particular area or that the area was above water at that time and was an area of erosion rather than deposition.

WELL OF L. E. MORROW, SANFORD, SEMINOLE COUNTY, FLORIDA.

A description of samples from this well has already been published (Florida Geological Survey, Fifth Annual Report, 1913, p. 219). There is record of the casing of the well to 100 feet.

The samples I have had are four in number, as follows:

- 95-100 feet. Water-worn fragments with black phosphatic pebbles and very few worn fragments of *Lepidocyclina*.
- 101-113 feet. Mostly calcite crystals.
- 113 feet. Typical Ocala. *Lepidocyclina*, *Operculina* and *Heterostegina*.
- 113 plus feet. Similar to the preceding.

PROBABLE STRATIGRAPHY.

The occurrence of *Lepidocyclina* somewhere between 95 and 100 feet indicates Oligocene strata in this section.

The occurrence of typical Ocala species at 113 feet and below very clearly indicates this formation at that depth.

From the record at Apopka and at other points it is probable that the Ocala rests upon the Lower Cretaceous here.

WELL OF H. BRADFORD, AT COCOA, BREVARD
COUNTY, FLORIDA.

A single sample from 190 feet shows typical Ocala species.

WELL NO. 3 OF THE PALMETTO PHOSPHATE COM-
PANY, NEAR PIT NO. 1 ABOUT 2¾ MILES
NORTHWEST OF TIGER BAY, FLORIDA.

A description of samples from this well has already been published (Florida Geological Survey, Seventh Annual Report, 1915, pp. 49, 50).

The well was cased to a depth of 620 feet. Certain discrepancies between actual log records and apparent stratigraphic results are given below. The examination of samples gives the following results:

- 30-300 feet. No foraminifera.
- 310 feet. Few poorly preserved foraminifera.
- 330 feet. Small fragments of *Lepidocyclina*.
- 337 feet. Small fragments of *Lepidocyclina*.
- 350 feet. No *Lepidocyclina* noted.
- 360-400 feet. Abundant *Lepidocyclina*.
- 410 feet. Abundant *Lepidocyclina* and abundant *Nummulites*.
- 420 feet. Abundant *Lepidocyclina* and few *Nummulites*.
- 450-530 feet. Abundant *Lepidocyclina* and abundant *Nummulites*.
- 535 feet. Abundant *Lepidocyclina* and numerous *Nummulites*.
- 540 feet. Very few *Lepidocyclina* and numerous *Nummulites*.
- 550 feet. Brown crystalline calcite and whitish material with numerous *Orbitolina*.
- 560 feet. Mixed material evidently from above.

- 570 and 580 feet. Entirely composed of entire and partly broken specimens of *Laganum* (?) *crustuloides* (Morton).
 590 feet. Mixture of various things from above.
 600 feet. Similar to 570 and 580.
 620-632 feet. *Orbitolina* mixed with things from higher levels.
 640-770 feet. Abundant *Orbitolina* alone.

DISCREPANCIES IN THE RECORD.

In the thick series in the Ocala at 410 feet occur abundant thick *Nummulites* after 40 feet of the Ocala. This becomes less in the sample from 420 feet and then does not reappear in quantity until 535 and 540 feet, where the same species occurs. This resembles a species found in the Upper Eocene of Northern Florida and Southern Alabama apparently occurring just below the Ocala. If this is correct the Ocala would be limited to the section from 360 to 400 feet and 40 feet thick, the other material below to 632 feet having fallen down or been drawn up from this section. This suggestion is here noted for further reference. It may be noted in addition that the material is almost entirely of very coarse fragments or whole specimens from 450 to 530 feet, showing comparatively little effect of the drill. The material at 550 feet is finely cut by the drill and consists largely of the debris of the echinoid noted. At 570, 580 and 600 feet the samples are almost entirely made up of whole or only partially broken specimens of this species. These are too large to have well escaped the drill and with lack of fine material would seem to be material drawn from the sides of the well from 400 feet or above rather than from the various depths below. This is even more strongly indicated by the occurrence with them of numerous specimens of *Orbitolina* characteristic of the Lower Cretaceous and found in abundance alone in the samples below. It is still more strongly indicated by the occurrence at 590, 620, 623, 632 feet of a mixed material containing *Lepidocyclina*, *Nummulites* and *Orbitolina* and very evidently in large part formed of material derived from above 400 feet.

PROBABLE STRATIGRAPHY.

Below 350 feet there is indicated at least 40 feet of Ocala Limestone equivalent to that found about Ocala. At 410 feet is

a bed largely made up of thick *Nummulites* and of Upper Eocene age. From 550 feet to 770 feet the Comanchean Lower Cretaceous is clearly indicated, the upper part of which and perhaps all belongs to the Fredericksburg Series.

CITY WELL AT FORT MYERS, LEE COUNTY, FLORIDA.

Depth of well 950 feet. Size 10 and 8 inches; casing 10 inches, 14 feet; 8 inches, 203 feet; principal water supply 875 feet.

A description of the samples from this well has been published (Florida Geological Survey, Seventh Annual Report, 1915, pp. 51, 52).

- 0-200 feet. No samples.
- 200-250 feet. No foraminifera.
- 280-680 feet. Few foraminifera at various levels.
- 720-760 feet. Numerous casts of *Miliolidae* including *Peneroplis*.
- 800 feet. Numerous casts of *Miliolidae* but without *Peneroplis*.
- 880 feet. Numerous casts of *Polystomella*.
- 900 feet. Similar to 720 feet. May have come originally from that level.
- 950 feet. Numerous casts of *Rotaliidae*.

PROBABLE STRATIGRAPHY.

The foraminifera as a whole are very unsatisfactory, represented by rare, poorly preserved specimens in the upper levels and by internal casts in the lower ones. The latter are identifiable only to the genus at best.

The series from 280 to 680 feet may be referred to the Miocene, probably the lower Miocene, suggesting somewhat generally the Chipola, allowing for the difference in ecological conditions between the two widely separated areas. The series from 720-950 feet represent very shallow water conditions both from the genera of the foraminifera and the lithological character of the samples. At 900 feet considerable quartz sand is present. With such material and the geographical distance between these and the known surface deposits nothing more than a guess can be made. On this basis alone it is suggested that some of it may represent the Tampa formation of the Upper Oligocene.

There is an absence of any specimens or fragments of *Lepido-*

cyclina or other forms that would suggest the Ocala and an entire absence of *Nummulites*. Also there are no specimens of *Orbitolina* nor traces of the brownish limestone associated with it. The inference thus may be drawn that no formations older than the Oligocene are represented here.

This lack of these formations is unexpected, for as the locality is nearly in a direct line between Bushnell, Tiger Bay and Marathon wells it might be expected to show both Ocala and Lower Cretaceous. Fort Myers is, however, somewhat to the west and if the general axis of the Florida peninsula is considered, is more to the west of that line than the other localities mentioned.

WELL OF THE OKEECHOBEE ICE AND ELECTRIC COMPANY AT OKEECHOBEE, OKEECHOBEE COUNTY, FLORIDA.

Depth of well 775 feet. Surface Pleistocene. Samples to 500 feet only. Casing, 150 feet of 10-inch, 307 feet of 8-inch, and 6-inch casing, amount not given.

- 41-56 feet. A very few foraminifera which suggests Pliocene.
- 56-62 feet. Broken specimens of little value.
- 65-81 feet. Rare broken specimens of little value.
- 87-500 feet. Specimens few and rare throughout but all are characteristically Miocene.

PROBABLE STRATIGRAPHY.

As the surface material is Pleistocene this is evidently limited to the levels above 41 feet. The Pliocene also is limited in its thickness for the sample marked "87-94 feet" is evidently Miocene. The Miocene seems to continue to the 500-foot level at least.

From the log of the well the following occur according to Selards, who examined the samples:

- 510 feet. White limestone rock with fragments of echinoderm spines.
- 608 feet. Chiefly sand.
- 615 feet. White limestone with many fossils.
- 775 feet. Limestone powdered fine by the drill.

WELL OF FLORIDA EAST COAST RAILWAY AT MARATHON,
ON KEY VACA, MONROE COUNTY,
FLORIDA.

Depth of well represented by samples 2,300 feet. The amount of casing used was 10-inch, 589 feet; 8-inch, 605 feet; 6-inch, 1,128 feet.

- 0-35 feet. No foraminifera.
- 35-78 feet. Few foraminifera. Pleistocene.
- 78-174 feet. No foraminifera.
- 180-412 feet. Scattered foraminifera. Miocene.
- 412-585 feet. Mostly quartz sands. No foraminifera.
- 589-628 feet. *Orbitolites* and *Gypsina*. Probably Tampa formation.
- 660 feet. Fragments of foraminifera—perhaps same.
- 682-755 feet. Hard limestone. No identifiable foraminifera.
- 786 feet. *Amphistegina*.
- 852 and 900 feet. *Heterosteginoides*. Unlike northern or central Florida. Cf. Panama.
- 984 feet. *Lepidocyclina*. Unlike northern or central Florida. Cf. Cuba.
- 1025-1115 feet. Hard limestones.
- 1210-1230 feet. Hard limestones.
- 1248 feet. Conical *Orbitolina* common.
- 1248-1318 feet. *Orbitolina* common, and at intervals to bottom of well.
- 1318-1328 feet. Flatter and larger specimens and at intervals to bottom of well.
- 1790 feet. Low, concave forms of *Orbitolina* and at intervals to bottom.

PROBABLE STRATIGRAPHY.

Pleistocene formations are indicated at least to 78 feet. The Pliocene is not definitely indicated although there is a barren stretch between the Pleistocene and the beginning of the Miocene which includes the series between 180 and 412 feet and probably at least part if not all of the quartz sands below 585 feet.

Oligocene begins as far as can be determined with the 589-foot sample to 628 and perhaps 660 feet. This seems to be of Tampa age.

At 852 and 900 feet the fossils no longer resemble those of northern and central Florida and there appears a genus I have described from the rocks of the Panama Canal Zone and found again in the Leeward Islands. This represents Middle Oligocene probably or the base of the Upper Oligocene. Below it at 984 feet

the first trace of *Lepidocyclina* appears and the Lower Oligocene. The species, however, is not like those of the Coastal Plain area, but is more like certain species of Cuba.

After a non-foraminiferal series of hard granular limestones conical *Orbitolina* is found at 1,248 feet and is scattered in the samples from this level down to the bottom of the well. Larger specimens occur than those found in central and northern Florida. This is evidently the Lower Cretaceous. From 1,318 feet occur large specimens with flatter tests and these in turn are scattered all the way down. At 1,740 feet and below are found the large species with the concave base representing probably the Trinity group of the Lower Cretaceous. Other Lower Cretaceous forms occur with the *Orbitolina* as in other wells.

GENERAL STRATIGRAPHY SHOWN BY THE WELL SAMPLES.

Two main groups of formations are the most easily determined when present from the abundance of their fossils. These are the Ocala limestone which is represented by several species of *Lepidocyclina*, *Heterostegina* and *Operculina* as well as smaller forms, and the Lower Cretaceous which is characterized by species of *Orbitolina*. In addition, below the Ocala is usually a horizon distinguished by an abundance of thick *Nummulites*.

The Ocala limestone, often termed Vicksburg in the older reports, has been shown by Cooke (U. S. Geol. Surv., Professional Paper 95-I, 1915) to be of upper Eocene age. There seem to be two facies at least of the Ocala in Florida, one that about Ocala the type locality where the most abundant fossiliferous genus is *Lepidocyclina* of several species without *Orthophragmina*. The other facies is characterized especially by various species of *Orthophragmina* and in some areas by a large *Lepidocyclina* as well, but of a different species from those of the Ocala region.

In the Coastal Plain area there is a development of *Nummulites* of the form found in the well samples of Florida and representing probably the upper Claiborne. Its position in the wells is especially valuable as marking a level somewhat below the base of the Ocala.

The Lower Cretaceous is marked by various species but es-

pecially by two species of *Orbitolina*, one a small sharply conical species, the other a large depressed form with usually a concave base. Other species are present in some of the wells, but these two are especially important.

Outside these Florida wells the only region in America where the small sharply conical species is known is in the Quitman Mountains of Western Texas near the Rio Grande River about 80 miles southeast of El Paso. Here it characterizes a horizon of the Fredericksburg Series of the Lower Cretaceous and is very abundant in that horizon. A species which seems identical with this is found in the Lower Cretaceous of the Province of Navarra in northern Spain on the southern slope of the Pyrenees. The specimens from these three remote areas, Texas, Florida and Spain, seem to belong to one species or very closely related species. This then settles definitely the age of the beds in which this conical *Orbitolina* is found.

Below the Fredericksburg in the same section in the Quitman Mountains, according to Stanton (in Cragin, Bull. U. S. Geol. Survey, No. 266, pp. 28-32, 1905) in the Trinity group of the Lower Cretaceous there are horizons marked by enormous numbers of *Orbitolina texana*. This is a large, depressed form with a slightly concave base. The larger concave species which occurs in the Florida wells at some distance below the smaller conical species very closely resembles *O. texana* and is closely related to it if not identical. In Europe similar species occur in the Neocomian, which seems to be the equivalent of the Trinity of Texas. Other species occur in the Aptian beds of Switzerland where, according to Chapman it forms a more or less massive rock called the *Orbitolina* limestone. The Upper Greensand in Devonshire, England, contains a bed almost entirely made up of another species of *Orbitolina*.

The two forms of *Orbitolina* would alone appear sufficient to define the Lower Cretaceous of these two series, but there are also in the Florida material other genera which in various species characterize the Gault and earlier Lower Cretaceous beds of Europe.

With these groups clearly defined their distribution in the well samples becomes a matter of the discovery of the highest levels at which they appear in the well samples.

LOWER CRETACEOUS.

Except for the well at Panama City in the western part of the State and the three across southern Florida at Okeechobee, Fort Myers and Boca Grande, the conical form of *Orbitolina* is found in all the wells or probably would have been if samples from the right depths had been available. The wells where it is not found; at Bushnell because samples began at too low a level; and at Sanford and Cocoa the samples are only* from the level of the Ocala and do not represent greater depths. The three wells across southern Florida would undoubtedly have shown this formation at deeper levels than those from which samples are available.

We may safely infer then that practically the whole of the peninsula of Florida and probably large areas of the submerged Floridian Plateau are underlain by limestones of the Lower Cretaceous at least as old as the Fredericksburg group. It seems also safe to assert that below these are other older beds of age corresponding to the Trinity or lowest group of the Lower Cretaceous. Still older horizons are indicated but until comparisons can be made with other areas, not at present available, the age of these is uncertain.

The position of the upper levels of the Lower Cretaceous as represented by the Fredericksburg can only be taken as the level at which the conical *Orbitolina* is first recognized. It may in places extend somewhat above this level but probably not to any great height. This level then can be determined. The level of the top of the well bore is not indicated in any instance but as a basis the height above sea-level of the town in which the well is located is taken. These are mostly given in the Fifth Annual Report of the Florida Survey. Assuming the height at Apopka as 150 feet above sea-level as the conical *Orbitolina* appears at 115 feet below the surface, the Lower Cretaceous beds here actually stand 35 feet above present sea-level.* Using the same data, at Eustis the Lower Cretaceous would be less than 100 feet below sea level and at Anthony 33 feet below sea level. In other localities it appears at St.

*According to levels supplied by the Atlantic Coast Line Railway to the Florida Survey, received subsequent to the preparation of this manuscript, the level of the depot at Apopka is 125 feet above sea, and the well is reported by Mr. Hull who preserved the samples as being 8 or 10 feet above the depot.

Augustine at 400 feet, Jacksonville at 820-845 feet, Tiger Bay at 500 feet and Marathon 1,248 feet below present sea level. Allowing for an even rate, this would give a dip to the south from Apopka to Tiger Bay of approximately 9 feet to the mile. Similarly the dip northward from Apopka to St. Augustine about 6 feet per mile and from Anthony northeastward to St. Augustine also about 6 feet per mile. From St. Augustine to Jacksonville the dip is sharper if the data are correct and nearly 10 feet per mile. All these represent fairly uniform conditions and very gradual slopes in a low anticline with its center somewhere in the general region of Apopka. Owing to the absence of samples from the upper portion of the Bushnell well and the lack of deep samples from Sanford and Cocoa, the east and west dip of the Lower Cretaceous cannot be determined.

The time of the slight folding into the anticline is an interesting problem. The fact that the horizon of the conical *Orbitolina* is approximately the same as or parallel to the upper surface of the Lower Cretaceous would tend to show that unequal erosion which would have taken place if it occurred soon after deposition has not taken place to any great extent. The evidence furnished by later formations tends to support this view.

In this connection the following statement of Vaughan (Dept. Marine Biology, Carnegie Institution of Washington, Papers from the Tortugas Laboratory, Vol. 4, p. 181, 1910) in speaking of the origins of the Floridian Plateau seems to have been very close to the actual facts.

"The Plateau existed in Vicksburgian, Lower Oligocene, time [the Ocala now considered as Upper Eocene] projecting as a submarine platform from the southeastern corner of the continental shelf and extending at least to its present southern limit. The forces by which this older Oligocene [Upper Eocene] platform was formed at present can only be the subject of speculation. It was due to some fold of the ocean bottom, perhaps in some way connected with the angle of the Piedmont area in central Georgia."

UPPER CRETACEOUS.

It seems safe to make the statement that so far as the well samples examined show, there are no Upper Cretaceous strata now

present in any part of the Florida peninsular. This is a very sweeping statement for so large a region involved, but the Upper Cretaceous is characterized by Foraminifera which should be easily recognized between the *Orbitolina* bed and the Ocala if they occurred.

The absence of Upper Cretaceous strata may be explained by subsequent erosion or that this whole area was a land mass during Upper Cretaceous time.

It is known that in late Lower Cretaceous times various areas of North America were elevated. Further if as indicated by Barrell there was a raising, without folding, of the western Piedmont and Appalachian areas at least several hundred feet at this time such movement may have taken place in Florida. If this occurred at the end of the Lower Cretaceous and the area was above water during Upper Cretaceous time there could not have been very great elevation at any time or there would be more evidence of inequalities of the surface. It is possible that there was a low elevation during this entire period and during that time the upper series of the Lower Cretaceous represented by the Washita series of Texas may have been worn away.

If the entire series of the Cretaceous were deposited and then subsequently removed it would have involved considerable uplift and the structure would probably be different from that now indicated.

EOCENE.

In the well samples the earlier Eocene seems to be entirely lacking but the Claiborne seems to be represented at least in the region northward from Tiger Bay by the bed containing abundant thick *Nummulites* and the upper Eocene by the Ocala from Tiger Bay northward with the exception of the Apopka region. The Nummulite bed can be considered with the Ocala as it seems to be conformable with that when found.

The Ocala was not recognized in the well samples examined from south of Tiger Bay and the well at Marathon indicates that it may not have been developed in its typical form much south of the Tiger Bay region. The Ocala was developed in comparatively shallow water as its fauna indicates. At any rate, in the Marathon

well on Key Vaca in southernmost Florida the Ocala is replaced by a foraminiferal fauna very much like that of the West Indian region at that time.

In the region northward from Tiger Bay the Ocala is present except about Apopka, where it was either eroded or not deposited, due to that area being at that time a land mass. If the Apopka region was an island during the deposition of the Ocala there should be evidence of this fact in the character of the Ocala as it approaches. From the fact that there is no evidence of the *Lepidocyclina* of Ocala age at Eustis, but as *Nummulites* of the lower bed do occur and as both are absent so far as seen at Apopka tends more to the idea that both have been eroded at Apopka than not deposited at all there.

Perhaps the most striking thing in connection with the Ocala is the finding that it is apparently only about 40 feet thick and that this thickness is very uniform. Various estimates in the literature give its probable thickness from two or three hundred to over a thousand feet. Some of the higher of these estimates were based on certain of the wells here considered. This thickness has undoubtedly come from the finding of the Ocala species through long series of well samples but represent simply specimens that have fallen from above. The limiting bed of thick *Nummulites* that lies developed just below the Ocala at Anthony and other places makes certain this greatly reduced thickness over previous estimates.

This erosion more probably took place when the area here and westward was above the water during a period probably late Oligocene and formed the area named by Vaughan (l. c. p. 182) "Orange Island." this area may have been an island in the Ocala sea.

The section between Apopka and Anthony passing through Eustis shows that there is apparently a slight syncline in the Lower Cretaceous in this place. This may tend to show that the Lower Cretaceous is not a simple great low anticline but that there may be numerous secondary minor flexures. This would indicate that there was at least some slight folding before the deposition of the Ocala. Also the known vertical distance between the Ocala and the underlying Lower Cretaceous ranges from around 60 feet at Anthony to 250 feet or more in some of the other wells. All these indications point toward an unequal level of the upper *Orbitolina* bed at the

time of the deposition of the Ocala limestone, assuming that the *Orbitolina* is limited to a single horizon.

However this may be, it is certain that after the Ocala had been deposited there has been a low anticlinal fold developed in the region in general similar to that already noted for the Lower Cretaceous. The present occurrence of the Ocala at the surface in west central Florida with dip toward the northeast, east, and south seems to indicate that there is a low anticlinal fold here extending to the part of the Florida Plateau to the west. This is further indicated by the high elevation of the *Orbitolina* level at Burns in Wakulla County to the northward of the present submerged portion of the plateau.

LOWER OLIGOCENE.

At Tiger Bay there are fragments of *Lepidocyclina* that may possibly of Lower Oligocene age but they are too poor to admit of specific determination and therefore the suggestion as to their age is not proven.

At Marathon the *Lepidocyclina* may be of either Lower Oligocene or Upper Eocene age but as it is not referable to any described species it is difficult to place it definitely. In the central and northern portions of the State the presence of Lower Oligocene in the well samples seems questionable.

MIDDLE AND UPPER OLIGOCENE.

The Tampa formation or its equivalent as characterized by *Orbitolites floridana* (Conrad) seems to be present in the well at Panama City, and at Marathon the two wells at the extremes of the State. Possibly some of the series in the Fort Myers well may be of this formation. Strata characterized by *Orbitolites* are widely distributed, occurring in Panama and at Anguilla in the Leeward Islands and in various parts of Florida. Except for the localities noted the well samples add little to the data on this formation.

MIOCENE.

From what can be learned from the well samples examined the Miocene deposits are of considerable thickness in southern Florida.

At Fort Myers 400 feet of the sediments are referred to the Miocene, at Okeechobee a slightly greater thickness and at Marathon nearly as much. This is based on the reference of these scattered foraminifera to the known Miocene of the northern part of Florida, perhaps not a safe comparison in consideration of the distance. However the Miocene of the Choctawhatchee Marl is similar in many respects and furnishes numerous species. The Jacksonville Miocene shows no Foraminifera but Miocene is indicated in the St. Augustine well.

PLIOCENE.

None of the wells give definite evidence of the presence of the Pliocene with the exception of Okeechobee, although this is probably present, especially in the southern part of the State between the Pleistocene and the Miocene. The fauna of the Caloosahatchee Marl is tropical in character and forms an excellent basis for comparison, but unfortunately little was found in the well samples to compare with it.

PLEISTOCENE.

The Pleistocene in the southern wells is indicated to some depth, 41 feet at Okeechobee and 78 feet at Marathon but little information is available from the other well samples.

REVIEW OF THE GEOLOGY OF FLORIDA

WITH SPECIAL REFERENCE TO STRUCTURAL CONDITIONS

By E. H. SELLARDS.

The First Annual Report of the Florida Geological Survey, issued in 1908, contains a brief sketch of the geology of Florida. In the same volume was included an account of the geological investigations that had been made in the State previous to the organization of the State Geological Survey, and also a bibliography of publications on Florida geology to the year 1907. In the present publication, the Twelfth Annual Report of the Survey, will be given a sketch of the geology of the State as understood at the present time, to which is added a supplement to the bibliography previously given. In the interpretation of the geologic problems of the State there is now available not only the investigations made by the Florida Geological Survey during the twelve years that have elapsed since the Survey was established, but also investigations by other organizations, among which in particular should be mentioned the U. S. Geological Survey through the division of Coastal Plains Geology. In addition there have been many individual scientists, as recorded in the bibliography, who have contributed to a knowledge of the geology of the State. It is a pleasure to acknowledge indebtedness to all these sources for information that has been used in this report.

It will not be the purpose in the present paper to present details that have been previously published in regard to formations, but rather to present general conclusions, and to give in particular the data that is available on structural conditions in the State. Of great value in this study is the report, on sub-structure based on well cuttings, made by Dr. J. A. Cushman, in this volume.

To those who have seen Florida but casually it may seem that the geology of the State is entirely obscured beneath the sand, soil and vegetation of the prevailing level surface. But to those

who have looked more closely it is apparent that such is not the case. It is true that the problems of geology are made more difficult by the lack of frequent and continuous exposures, but they are not necessarily made impossible of solution. The numerous stream channels, railway and public road cuts, drainage canals, and drilled wells afford records from which the stratigraphic succession and structure of formations may, with patience and persistence, be worked out. Fortunately many of the formations of the State are richly fossiliferous. Nowhere else in the United States do the Tertiary and Quaternary formations contain a more abundant, more varied, or better preserved marine invertebrate fauna than in Florida. In this respect there is an embarrassment of riches. Dr. Dall in his study of the fossils of the Caloosahatchee marl, recognized in that formation alone the presence of more than 600 species of mollusks. Vertebrates, although as a rule not so well preserved as the invertebrates, are relatively numerous. No state east of the Mississippi, perhaps, contains so many Tertiary and Quaternary vertebrates as does Florida. Fossil plants, although less abundant than either invertebrates or vertebrates, are not wanting. It is seldom the case that a single formation holds both land and marine fossils, yet, something of an insight into the interrelation of the marine invertebrates, land animals and land plants is secured in the Florida Miocene and again in the Florida Pleistocene. In the study of the fossils Florida is in many respects a State of exceptional opportunities.

TOPOGRAPHY

In topographic details and surface configuration Florida is by no means lacking in variety. In this respect the State presents much greater diversity than would have been anticipated in view of the fact that the maximum elevation within the State scarcely exceeds 300 feet above sea level. In the upland section of the State the intimate relation between topography and geology becomes apparent. The limestones under the influence of a heavy rainfall and an excess of humic acids in the ground water have dissolved rapidly, and when lying near the surface have produced a characteristic topography. The lowlands bordering the coast, on the other hand, have been but little affected by erosion, and in

these areas the surface is perhaps but slightly modified from its original condition. Of the land area of the State approximately one-half lies below the 50-foot contour line. This belt of land below the 50-foot contour includes all of the peninsula south of the northern end of Lake Okeechobee, and in addition, a strip of varying width bordering the Atlantic and the Gulf coasts. Aside from beach deposits and sand-dunes, this belt of country is prevailing level. The surface deposits are usually sandy, although as will be subsequently indicated, limestones underlie considerable areas.

The higher lands of the interior of the State present for the most part topographic features that are difficult of description, owing to the apparent irregularity and lack of system of the hills and valleys. Over much of this area the topographic features are the result of the solution of the underlying calcareous deposits, and the prevailing surface configuration includes depressions or solution basins of varying size and depth, and hills of varying size and height. Within the area, the topography of which is controlled by underlying calcareous deposits, are two subdivisions which are worthy of special mention. These are the "sink-hole region" which lies chiefly along the west flank of the peninsula, and the "lake region," which lies for the most part near to or somewhat east of the center of the peninsula. In the sink hole region the limestones lie at no great depth. The sinks which form as a result of the solution of the limestones, thus allowing the covering to fall in, usually reach through when first formed, to permanent water level, thus forming small circular lakes. In the lake region the calcareous rocks are covered to a greater depth. The lakes are usually circular in outline and are deep with high banks.

In extreme Western Florida, including Escambia and Santa Rosa counties, the calcareous deposits are buried beneath the surface to such a depth as not to affect the topography. A similar region is found on the east bank of the Apalachicola River, including Gadsden and the northern part of Liberty counties. Under these conditions the topography is determined by the normal drainage courses.

ELEVATIONS

Only in thirty-one quadrangles in Florida have detailed topographic surveys been completed.* Each quadrangle includes an area of 15' of latitude and 15' of longitude, about $17\frac{1}{2} \times 15\frac{1}{4}$ miles. The area, topographically surveyed, about 8,000 square miles, is, therefore, slight as compared to the whole area of the State, which is 54,861 square miles. Aside from these topographic surveys, bench marks have been established recording exact elevations at places throughout the State by the U. S. Coast and Geodetic Survey, the U. S. Geological Survey, and the U. S. Army Engineers. In addition, many lines of approximate or working levels have been made in connection with the construction of railways, public roads, drainage canals, and other natural improvements. With the aid of this data the elevations in the greater part of the State may be determined within approximate limits. There are, however, very considerable areas the elevation of which is not so well determined as is desirable for both general and specific purposes. It is especially desirable that additional topographic maps be made. A complete record of bench marks established in Florida by the U. S. Geological Survey and the U. S. Coast and Geodetic Survey previous to 1911 will be found in Bulletin No. 516 of the reports of the U. S. Geological Survey. Of the bench marks established since that time, those in Jefferson, Leon and Gadsden counties are listed in the Ninth and Tenth Reports of the Florida Survey. In the Fifth Annual Report, pp. 81-101, was given a list of elevations at railway stations in Florida. In the present volume there is included a compilation made by Mr. H. Gunter, of all approximate and exact levels recorded within the State.

CLIMATE

The climatic conditions in the State are appreciably influenced by the proximity to oceanic waters. This is especially noticeable with regard to temperature, rainfall and humidity. The temperature is moderate, the rainfall moderately heavy and the humidity high.

*Of this number a few quadrangles on the Georgia-Florida border are partly in Georgia.

TEMPERATURE

The mean annual temperature near the northern line of Florida is about 67° F., while at Key West, in extreme Southern Florida, the mean annual temperature is close to 77°. In the table included in the following paragraph is indicated the maximum and minimum recorded temperatures for a number of stations in the State.

RAINFALL

By far the greater part of the State lies within an area which receives between 48 and 57 inches annual rainfall. In extreme Southern Florida on the Keys is a small area in which the rainfall is much less, the average for the station at Key West being about 38 inches. On the other hand, a small area in extreme Western Florida and another along the South Atlantic Coast receive an annual rainfall approximating 60 inches. The average annual rainfall for the State as a whole is close to 54 inches. The rainfall is distributed irregularly throughout the year. The driest months are April and November, while the heaviest rainfall comes as a rule from June to September. In the following tables is given the mean annual rainfall for a number of stations in the State, and the mean annual rainfall by months for the State as a whole.

Table of Temperature and Rainfall. From Climatology of the United States, U. S. Weather Bureau, Bulletin Q, 1906.

	Temperature			Annual Rainfall		
	maximum	minimum	mean	maximum	minimum	mean
Archer -----	101	10	69	76.7	41.6	54.9
DeFuniak Springs -----	105	0	67	75.1	60.5	67.8
Fort Myers -----	94	24	73	82.7	40.2	55.1
Jacksonville -----	104	10	69	82.1	38.7	53.4
Key West -----	100	41	77	58.4	22.1	37.9
Miami -----	96	29	75	76.7	42.5	58.3
Pensacola -----	103	7	68	81.1	35.5	56.8
Tallahassee -----	97	-2	67	69	44.9	58.2
Tampa -----	96	19	72	67	42.1	53.1

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Table of Mean Annual Rainfall by Months. Tabulated from U. S. Weather Bureau, Climatological Data, Florida Section, 1916.

Mean Average Temperature		Mean Average Precipitation	
January	----- 58.4 degrees		3.11 inches
February	----- 59.9 degrees		3.60 inches
March	----- 65.4 degrees		3.15 inches
April	----- 69.6 degrees		2.41 inches
May	----- 75.8 degrees		4.00 inches
June	----- 80.0 degrees		6.58 inches
July	----- 81.5 degrees		7.14 inches
August	----- 81.4 degrees		7.55 inches
September	----- 79.5 degrees		6.98 inches
October	----- 73.0 degrees		4.09 inches
November	----- 65.3 degrees		2.14 inches
December	----- 59.6 degrees		2.61 inches
Year	----- 70.8 degrees		53.36 inches

Variation in rainfall is pronounced in Florida. This variation is due in part to normal seasonal variations, and in part to the influence of heavy tropical storms, especially those of the late summer and fall. These storms or hurricanes, which, fortunately, are not of frequent occurrence, usually result in a heavy precipitation in the belt of country through which they pass.

The maximum recorded precipitation for one year in Florida is probably that of 1912, at which time the average rainfall for the State was 64.88 inches (Climatology Report, 1912). The maximum for any one station during this exceptional year was 91.61 inches at Molino in Escambia county. The maximum recorded rainfall for any one month at a single station is 31.26 inches which is credited to August, although in July, 1916, the rainfall at Bonifay in Holmes county was 30.6 inches. The rainfall of a single storm lasting somewhat more than one day has been known to exceed 10 inches. The rainfall for a period of twenty-four hours is known to have been as much at a single station as 13.18 inches. This rainfall was at Jupiter and recorded in October. As much as 3.90 inches is recorded as having fallen in one hour at Tampa in August. (Climatological Data, Section 84.)

DRAINAGE.

The drainage conditions in Florida are in some respects exceptional. In that part of the State in which limestones are near the surface, especially on the upland limestone section of the interior, the drainage is largely subterranean, although much of the water that thus enters the earth reappears through large springs which supply streams. In the limestone belt the rainfall enters the earth either directly through the surface materials or through disappearing streams which discharge their flow into the porous rocks. The subterranean drainage is best developed in that part of the State known as the "lime sink" region, where, aside from the main rivers, there are few or no surface streams. Partial subterranean drainage, however, is characteristic of a very much larger area, and for the State as a whole, the average for surface run-off is low.

The prevailingly level country over much of the State, together with porous soils, results in but limited surface wash. However, in the more hilly parts of the State the wash of roadbeds and soils under the influence of heavy rains is sometimes serious.

The streams of Florida for the most part have a slight gradient and are slow moving. The drainage of the westward extension of the State is through numerous streams, of which the Apalachicola is the largest, having a general north-south direction. The drainage basins of the peninsula are for the most part ill-defined. The St. Johns River, which flows north, and the Kissimmee River, which flows south, receive much of the drainage of the Atlantic slope. Entering the Gulf of Mexico from the western slope of the peninsula are a number of streams, among which are the Suwannee, Withlacoochee, Hillsboro and Caloosahatchee rivers.

GEOLOGY

Florida lies entirely within the Coastal Plains province, and the formations exposed at the surface are all of the Cenozoic period. The amount of limestone in Florida is relatively large; nevertheless, a very considerable quantity of sedimentary material, including sand, clay and flint pebbles, was carried to the south and included in some of the Florida formations. The progress made in

recent years in the study of the geology of Florida has made necessary a number of changes in the classification of the formations of the State. Of the formation names formerly in use, one or two have been discarded, and on the other hand, several new names have been added. The classification which at present best represents our knowledge of the geology of the State is expressed in the following table. A recently discovered fact in regard to the geology of Florida is the presence of Comanchean formations forming the sub-structure of the peninsula and extending as far west at least as Tallahassee.* Scarcely less remarkable is the complete absence so far as any records yet obtained indicate of the Cretaceous formations (Upper Cretaceous). If any of these formations were present they were removed by erosion previous to the deposition of the late Eocene formations. Their absence in any case can be accounted for only by a long period previous to the late Eocene, during which the Florida land mass stood above water level. The earth structure by which this peninsular land mass was produced thus dates back at least into the Mesozoic era.

TABLE OF GEOLOGIC FORMATIONS IN FLORIDA

Pleistocene

Palm Beach Limestone
 Miami Oolitic Limestone
 Key Largo Limestone
 Key West Limestone
 Lostmans River Limestone
 Ft. Thompson Beds

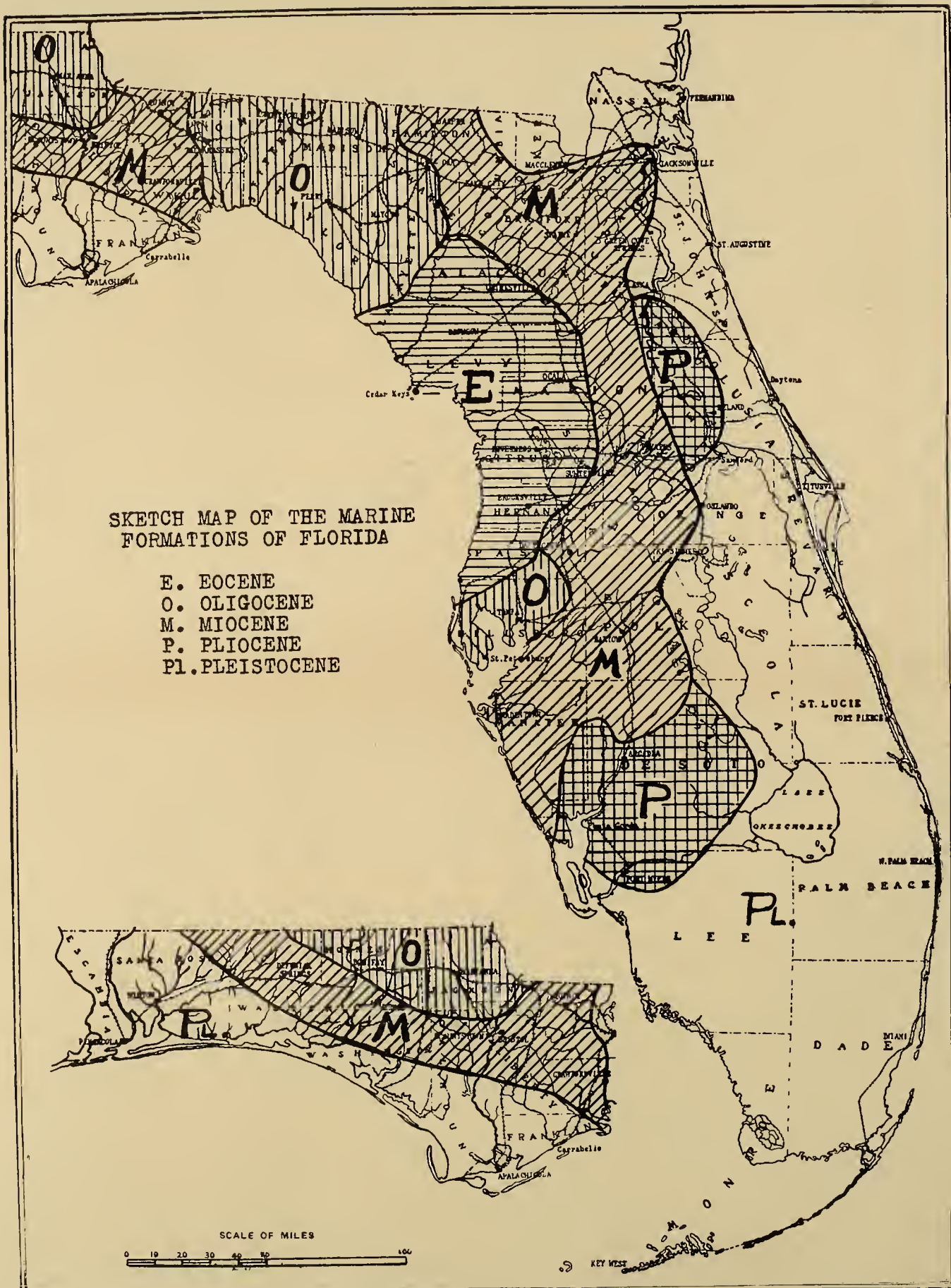
Pliocene

Bone Valley Formation
 Alachua Formation
 Caloosahatchee Formation
 Nashua Formation

Miocene

Choctawhatchee Formation
 Jacksonville Formation
 Alum Bluff Formation

*Cushman, Joseph, A., This volume.



Oligocene

Tampa Formation
Chattahoochee Formation
Vicksburg Formation

Eocene

Ocala Formation
Claiborne Formation

Cretaceous, not known in Florida

Comanchean, known only from well cuttings

STRATIGRAPHIC SUCCESSION

COMANCHEAN FORMATIONS.

The oldest formations that have been recognized in Florida are those encountered in well drilling and known at present only from well cuttings. The fossils found in these cuttings indicate the presence of Comanchean formations under all of the peninsula and a part, at least, of West Florida. The discussion of these formations, together with the data from which they have been determined, has been given by Dr. J. A. Cushman in the Twelfth Annual Report of the Florida Geological Survey. The thickness of the Comanchean underlying Florida has not been determined. The formations are chiefly limestone. The Cretaceous (Upper Cretaceous) is wanting in all deep wells of which record has been obtained.

EOCENE.

The Eocene deposits are represented in Florida by the Claiborne and Ocala formations. The Claiborne formation comes into Florida for only a short distance on the Choctawhatchee River, near the Georgia-Florida border. Where exposed on the Choctawhatchee River, this formation consists of a glauconitic calcareous sandrock, exposures of which are seen at intervals on the river banks for about one and two-third miles down stream from the Georgia-Florida line, beyond which it passes below the bed of the river. The thickness of this formation in Florida has not been determined. The Ocala formation as developed in Florida consists for the most part of very pure limestone. Fossils are abun-

dant, although many of the mollusks are preserved only as casts. The rock, as a rule, is granular and porous, although in places, by replacement, it has become close grained and compact. Masses and layers of flint, representing limestone replaced by silica, are of frequent occurrence in this formation. Aside from the flint masses, much of the rock consists of soft white limestone or marl. This formation is exposed to a limited extent on the Chipola River near Marianna, and also over a considerable area in central peninsular Florida. According to recent studies by Cushman, the thickness of the formation is very moderate, in places not exceeding 40 or 50 feet.

OLIGOCENE.

The Oligocene, as limited by recent investigations, includes in Florida only the Vicksburg, Chattahoochee and Tampa formations. The Ocala formation, which had been placed by Dall and others in the Oligocene, has been placed in the Eocene upon the evidence of the molluscan fauna as determined by Cooke.* The Alum Bluff formation, on the other hand, formerly referred to the upper Oligocene, has been placed in recent years in the Miocene on the evidence of the vertebrates and invertebrates.†

The Vicksburg formation consists of limestone lithologically not unlike those of the Ocala formation. Exposures of the Vicksburg formation are found in Florida near Marianna and Chipley, in Jackson and Washington counties. The Chattahoochee and Tampa formations which apparently are, in part at least, contemporaneous in deposition, constitute the upper part of the Oligocene as developed in Florida. The Chattahoochee formation is well exposed on the Chattahoochee River from the Georgia-Florida State line to Rock Bluff, a distance of about twelve miles. Another considerable belt of exposures of this formation is found extending from the Ocklocknee River to or somewhat east of the Suwannee

*The age of the Ocala Limestone; U. S. Geological Survey, Prof. Paper 95, pp. 107-117, 1915, by C. W. Cooke.

†Fossil vertebrates from Florida; a new Miocene fauna; new Pliocene species; the Pleistocene fauna; Florida State Geological Survey, 8th Ann. Rept., pp. 77-119, 5pls., 1916, by E. H. Sellards. Santo Domingo Type Sections and Fossils, *Bulletins Amer. Paleontology* Vol. 5, No. 30. Correlation table, 1917. By Carlotta J. Maury.

River, and from the Georgia-Florida State line to the Gulf border. The formation as exposed on the Apalachicola River includes impure clayey limestones. A rather harder and perhaps more nearly pure limestone phase of the formation shows between the Ocklocknee and Suwannee Rivers. The Tampa formation is exposed on the Hillsboro River and on the Manatee River near Tampa. It is likewise a limestone varying in hardness and in purity. The thickness of the Oligocene in Florida is difficult to determine, since there are no surface exposures that afford a measurement of the combined thickness of the formations. The evidence from well records as to the thickness of these beds is at present too indefinite to be of service.

MIOCENE.

The Miocene of Florida includes the Alum Bluff, Jacksonville and Choctawhatchee formations. The Alum Bluff formation, formerly referred to the Oligocene, as already noted has been placed in the Miocene on the evidence of the vertebrate and invertebrate fossils. The materials of this formation include calcareous sands and sandstones varying to sandy limestones, calcareous clays, fullers earth clays and sands. The conditions under which the formation was deposited were evidently shallow water often in the presence of conflicting currents. This is especially true of the upper part of the formation, in which cross-bedding is not uncommon. Fossil plants are found in this formation at the type locality at Alum Bluff. At the fullers earth mines in Gadsden county there is found a limited, although extremely interesting land vertebrate fauna, associated with a shallow water invertebrate fauna. Farther to the west, on the Choctawhatchee and Yellow Rivers, the formation is more distinctly marine and contains an abundant marine invertebrate fauna. In the southern part of the State the deposits which are believed to represent the equivalent of the Alum Bluff formation are distinctly phosphatic. As there developed, the formation consists chiefly of marl beds in which is included black, brown and white phosphate pebble. Deposits found on Black Creek in Clay county and referred to the Jacksonville formation are lithologically very similar to the Alum Bluff formation as developed in South Florida, and contain similar phosphate pebble.

The Choctawhatchee formation is later in age and overlies the Alum Bluff formation. It is chiefly a loosely cemented shell marl, formed in shallow water and often quite sandy. The surface outcrop of this formation occupies a narrow belt extending in a general east-west direction from west of the Choctawhatchee to somewhat east of the Ocklocknee Rivers. In determining the thickness of the Miocene it is necessary to rely on well samples. At Jacksonville the Miocene apparently extends from near the surface (about 33 feet) to possibly as deep as 500 feet, giving for the formations of this period a thickness approximating 450 feet. Probably at least 400 feet of the section of the well at Ft. Myers is likewise to be referred to the Miocene, while in the well at Okeechobee the Miocene approximates 400 feet in thickness.

PHOSPHATE IN THE MIOCENE.

Phosphate rock in considerable quantity appears for the first time in the Lower Miocene,* (Alum Bluff formation) the phosphates of both the Alachua and Bone Valley formations having been derived from this formation; the hard rock chiefly by chemical, the land pebble phosphate chiefly by mechanical segregation.† While the processes of concentration to workable deposits can be reasonably well followed there remains the problem of the origin of the phosphate in the Alum Bluff formation itself. The Eocene and Oligocene formations of peninsular Florida, are calcareous, some of them being very pure limestones. During the Lower Miocene however, the conditions were changed to such an extent that very considerable quantities of land-derived sediments were carried into northern Florida. This change was perhaps gradual as the lower part of the Alum Bluff formation is more calcareous than the upper part. Likewise the Alum Bluff formation of south-

*In samples from a well at Apopka, subsequently described, phosphate pebble is found to a depth of 220 feet. In the samples from this well Dr. Cushman finds foraminifera indicating the Comanchean at and below 115 feet. Whether the pebble phosphate belongs in the rock to this depth or has fallen from above remains to be determined. Elsewhere pebble phosphate is not present in the Comanchean.

†Sellards, E. H. Origin of the Hard Rock Phosphate Deposits of Florida, Florida State Geol. Surv., 5th, Ann. Rept., pp 23-66, 1913; The Pebble Phosphates of Florida, *ibid*, pp 25-116, 1915.

ern Florida is more calcareous than the same formation in Northern Florida. At Alum Bluff land plants are preserved in this formation, and in the fuller's earth mines are found land vertebrates. In south central Florida more or less marl is found in the Alum Bluff formation and in Southern Florida a deposit of marl of great thickness was accumulated during this time. It seems probable that the phosphates of the Alum Bluff formation, from which in later times were formed the workable phosphate beds of Florida, accumulated through chemical or biochemical processes in warm shallow seas in which was deposited the great marl bed of the formation.

PLIOCENE.

Four formations in Florida, more or less well differentiated, are referred to the Pliocene. These are the Nashua and Caloosahatchee marls, and the Bone Valley and Alachua formations. The two first mentioned are marine formations. The Nashua marls are well developed on the St. Johns River in Putnam and Volusia counties. The Caloosahatchee marls find their typical development on the Caloosahatchee River. Both formations contain an abundant fauna of well preserved invertebrates. The Bone Valley formation which contains the workable pebble phosphate deposits is well developed in Polk and Hillsboro counties. This formation is evidently of shallow water origin and is in part at least estuarine. It represents material re-accumulated during Pliocene time, derived chiefly from the disintegration of the nearby Miocene deposits. The Alachua formation likewise represents a reworking of materials derived from the disintegration chiefly of the Miocene deposits, and to some extent also of the older formations on which this formation rests. The Alachua formation contains the workable deposits of hard rock phosphate. Both the Bone Valley and Alachua formations contain a vertebrate fauna on the basis of which the formations are referred to the Pliocene. The origin and characteristics of these two formations have been more fully described in the Fifth and Seventh Annual Reports of the Florida Survey. The Nashua and Caloosahatchee formations are described in the Second Report of the Survey. The Bone Valley formation rarely exceeds 100 feet in thickness and as a rule is less. The Alachua formation likewise is usually less than 100 feet in

thickness. Both the Nashua and Caloosahatchee formations so far as known, are thin and may not exceed 50 or 100 feet.

PLEISTOCENE.

The Pleistocene formations of Florida include river, alluvial and marine deposits. Alluvial Pleistocene deposits are widely distributed over the State, especially in the stream valleys. In places these stream deposits contain vertebrate and invertebrate fossils. Among localities that have afforded important collections of vertebrates are Peace Creek, the Caloosahatchee River, and the drainage canals. At Vero in St. Lucie County a drainage canal cutting through a stream bed has afforded an especially interesting collecting locality for vertebrates, land and fresh water invertebrates and marine invertebrates. This locality has been fully described in the Eighth, Ninth and Tenth Annual Reports of the Survey.

The marine or chiefly marine Pleistocene deposits of the State have been described under the heading of Palm Beach Limestone, Miami Oolitic Limestone, Key Largo Limestone, Key West Limestone, Lostman's River Limestone, and Ft. Thompson beds. The five first named are all of marine origin. The Ft. Thompson beds include an alternation of fresh water and marine deposits. All of these deposits are found in southern Florida and the interrelation of the several named units remains to be determined on more detailed stratigraphic work than has as yet been done. The Ft. Thompson beds are described in a paper included in the present volume. The other limestones are described in detail in the Second Annual Report of this Survey.

GEOLOGIC SKETCH MAP.

The accompanying sketch map shows in a general way the surface distribution of the Florida formations. Owing to the small scale of the map it has been necessary to combine the formations. It is also impracticable to show limited exposures, such for instance as the exposures of the Ocala Eocene on the Chipola River near Marianna, or of the Claiborne Eocene on the Choctawhatchee River near the Georgia-Florida State line. Out-liers and remnants of some of the formations are omitted for the same reason.

Thus over both the Eocene and the Oligocene of peninsular Florida are found remnants of the Lower Miocene, indicating, probably the former extension of the Alum Bluff formation over the entire State. No attempt has been made to show the Alachua formation which rests chiefly upon the Eocene of Alachua, Levy, Marion and Citrus counties; nor the Bone Valley formation which rests upon the Miocene of Polk and Hillsboro counties. The alluvial Pleistocene deposits are likewise omitted from the map, and also the limited exposures of Pliocene (?) on the St. Mary's River.

STRUCTURAL CONDITIONS IN FLORIDA

WEST FLORIDA.

The structural conditions in that part of West Florida between the Choctawhatchee and Aucilla Rivers has been discussed in some detail in the Ninth, Tenth, and Eleventh Annual Reports. In those reports it is shown that a broad structurally high area centers between the Choctawhatchee and Apalachicola Rivers, the axis being nearer probably to the Choctawhatchee than to the Apalachicola River. It is also shown that a broad shallow syncline lies between the Apalachicola and Ocklocknee Rivers, the axis of the syncline having apparently a general northeast southwest direction. East of the Ocklocknee River was noted likewise a slight structurally high area not well defined. To this data Cushman has now added the identification of the Lower Cretaceous at the depth of 325 feet (or higher) in the well of the Bonheur Development Company in Wakulla County east of the Ocklocknee River. In a well near Panama City west of the Apalachicola River he finds fossils suggesting the Oligocene at 300 feet and more doubtfully the Eocene at 400 feet. The description of the samples from this well, which has not heretofore been published, is as follows:

Description of Samples from Well near Panama City, well located in N. W. $\frac{1}{4}$, 23, T. 4 S., R. 14 W.

- 1-30 feet. Chiefly sand with some shell fragments.
- 30-60 feet. Sample preserved as representative of this interval is a dark colored alum tasting clay, apparently the same clay exposed at Alum Bluff.

- 60-100 feet. Chiefly gray sand marl. The sand grains are clear quartz held together by calcareous cement.
- 100-200 feet. Buff colored clayey marl, enough clay to become slippery when wet. One sample.
- 200-300 feet. Mixed sample including a greenish sandy marl and a light colored calcareous marl.
- 300-350 feet. Limestone.
- 350-400 feet. Gray clayey marl. One sample.
- 400 feet. Sample at 400 feet, is light colored limestone.
- 460 feet. Sample reported from 460 feet, is a smooth rounded black phosphate nodule. Probably dropped from above.
- 470 feet. Light colored limestone.

The samples from this well from 30-60 and 60-100 feet seem definitely to represent the Alum Bluff formation, which is thus unexpectedly near the surface at this place.

The depth to the Eocene limestone in extreme western Florida has not been determined. From the character of samples reported from the well of the Southern States Lumber Company between Muscogee and Cantonment in Escambia County, described as "green clay," it seems likely that the Eocene limestones there lie at a depth greater than 890 feet from the surface. The data regarding substructure in that part of the State, however, is too limited at present to be reliable.

PENINSULAR FLORIDA.

THE RELATION OF THE FLORIDA PENINSULA TO THE COASTAL PLAIN

An unusual structural feature in coastal plains geology is the great Floridian plateau which, projecting from the mainland, separates the Atlantic Ocean from the Gulf of Mexico. The time of origin of this plateau may not be determinable, although it is now known to have been in existence and to have formed a large shallow water area as early at least as the Lower Cretaceous or Comanchean period. Although affected by diastrophic agencies, including elevation and depression, this plateau has continued as a structural feature from the Comanchean or earlier to the present time.

STRUCTURE OF PENINSULAR FLORIDA.

For some years the Florida Geological Survey has been collecting well logs and well cuttings with special view to determining so far as practicable the structural conditions underlying peninsular Florida. This work has progressed slowly, although some data have now accumulated that have a very important bearing on this problem. Early in 1918 cuttings containing numerous foraminifera from a deep well then recently completed in Sumter County were sent to Dr. T. W. Vaughan of the U. S. Geological Survey, by whom they were referred to Dr. J. A. Cushman. Dr. Cushman's identification of the foraminifera of these samples led to the very unexpected result that they indicated the presence of Comanchean (Lower Cretaceous) formations. Subsequently Dr. Cushman undertook the identification for the Survey, of the foraminifera in the cutting from about fifteen wells in Florida. This work was completed early in 1919 and the report on the well samples is published herewith. In addition there are a number of other wells that from logs or partial sets of samples give approximate data of service in this study.

SKETCH MAP OF STRUCTURAL CONDITIONS IN FLORIDA.

Upon the basis of all data available at this time there has been constructed a sketch map which represents approximately what is known of structural conditions in the peninsular section of Florida. On this map there is indicated an area in the west central part of the peninsula, marked "A", in which the top of the Eocene limestones lie at or above sea level. The data for placing the eastern margin of this area are very limited and the boundaries are necessarily very roughly approximated. In the lake region of Clay County in particular it is possible that the Eocene limestones may lie closer to the surface than is here indicated. The following description of samples from two wells at Apopka within this area has not been published heretofore.

Record of the City well at Apopka, Florida. Drilled February 1915. Mr. Starbird, driller. Samples submitted by Mr. S. G. Hull. Casing rested at 117 feet.

Depth of sample from surface.

- 50 feet. Brown sand medium fine.
- 60 feet. Light brown sand with slight mixture of clay.
- 115 feet. Broken shell rounded black phosphate nodules, and part of tooth of a ray.
- 140 and 150 feet. Greenish colored calcareous sands with black phosphate pebbles.
- 160 feet. Clayey calcareous sands with black phosphate pebbles.
- 170 feet. Light colored sandy marl with black phosphate pebble.
- 180 feet. Sandy marl with an abundance of black phosphate pebble and some coarse sand.
- 190 feet. Coarse calcareous sand or sandy marl.
- 200 feet. Coarse calcareous sand or marl and phosphate pebble.
- 210 feet. Soft light colored marl occasional phosphate pebble.
- 230 feet. Light colored limestone or marl, granular.
- 250 feet. Light colored limestone or marl, granular.
- 350 feet. Soft white limestone or marl. Sample discarded as some doubt about label.
- 380 feet. Soft white limestone or marl.
- 390 feet. Soft white limestone or marl.

Record of well used for City water supply at Apopka, drilled May-June, 1915. Driller Mr. Starbird, samples sent by Mr. S. G. Hull. Casing rested at 124 feet.

Depth of Samples.

- 60 feet. Blue calcareous clay.
- 70 feet. Very sandy shell marl; including phosphate pebble.
- 80 feet. Very sandy shell marl; including phosphate pebble.
- 85 feet. Very sandy shell marl; including phosphate pebble.
- 100 feet. Very sandy shell marl; including phosphate pebble.
- 103 feet. Coarse gray sand and gray fragments. Black phosphate pebbles.
- 104 feet. Coarse gray sand and gray fragments. Black phosphate pebbles.

These two samples which are identical are combined.

- 106 feet. Coarse sand, black phosphate pebbles and shell fragments.
- 114 feet. Light colored sandy marl with shell fragments, black phosphate pebbles.
- 122 feet. Light colored marl with shell fragments.
- 130 feet. Very light colored or white marl with some sand and shell fragments.
- 140 feet. Light colored marl with some phosphate pebble and shell fragments.
- 160 feet. Light or cream colored marl with phosphate pebble and some sand.
- 165 feet. Light cream colored marl with phosphate pebble and some sand.
- 170 feet. Light or cream colored marl with phosphate pebble and some sand.

- 175 feet. Light or cream colored marl with phosphate pebble and some sand.
- 180 feet. Very sandy calcareous material including phosphate pebble.
- 185 feet. Very sandy calcareous material including phosphate pebble.
- 194 feet. Very light colored soft lime rock including some sand.
- 220 feet. Very soft white lime rock or marl, including some black phosphate pebble.
- 230 feet. Lime rock breaking into small angular fragments.
- 240 feet. Lime rock breaking into small angular fragments.
- 250 feet. Light colored lime rock.
- 310 feet. Light colored lime rock.
- 330 feet. Light colored lime rock breaking into angular fragments.
- 333 feet. Lime rock breaking into somewhat coarse angular fragments.
- 336 feet. Lime rock breaking into somewhat coarse angular fragments.

SUMMARY OF RECORD.

- 1 to 60 feet reported sand, clay or sand and clay, Sample not preserved.
- 60 feet, stratum of blue calcareous clay.
- 70 to 100 feet, gray very sandy shell marl, including phosphate pebble.
- 103 to 106 feet, coarse sand containing phosphate pebbles and some shell fragments.
- 114 to 220 feet, prevailing light colored marl contains small phosphate pebbles.
- 230 to 336 feet, limestone rock which breaks into angular fragments suggestive in shape of small plates from echinoderms. This horizon is similar in lithology to that found at Tiger Bay at a depth of about 300 feet.

Interpretation: The interval from 60 to 115 feet is represented in the first well by two samples, and in the second by eight samples. A number of fossil shells have been obtained from these samples but the species not having been identified, the age of the formations remains undetermined. The interval from 140 to about 220 feet is represented by eight samples from the first well and nine samples from the second well. From the lithology of these samples the writer was inclined originally to refer this part of the section to the Alum Bluff formation. However, Dr. Cushman finds that these samples contain foraminifera which indicate that the formations are of Comanchean age. This is very unexpected, especially as the samples contain the pebble phosphate not elsewhere reported from the Comanchean formations. Below 115 feet, according to the fossils in samples submitted to Dr. Cushman is to be regarded as Comanchean (Lower Cretaceous). Addi-

tional samples should be obtained from wells in this section in order to determine more definitely both the lithology and the fossils of these formations. The casing in the two wells rests at 117 and 124 feet respectively. Nevertheless, it is not impossible that the phosphate pebble in the samples below 115 feet have fallen from above.

A second area is marked off on the map, B, in which generally speaking the top of the Eocene limestones appear to lie below sea level, but at no place in excess of 200 feet below sea. These two areas, it will be noted, make up together a broad belt extending across and occupying all of the north central part of the peninsula from the Gulf to the Atlantic coasts. The data on which this belt is mapped is derived in part from surface exposures and in part from well records. The upper course of the Suwannee River in Florida is known to lie in a structurally low area since in following the course of this stream it passes towards the Gulf onto successively older formations. Since in Hamilton County the Alum Bluff Miocene is exposed at elevations not exceeding 75 feet above sea it is surmised that the Eocene will be found in this general area to lie below sea level. From numerous wells drilled at Jacksonville it is known that the Eocene limestones there lie about 500 feet below sea level. On the other hand at Riverdale on the St. Johns River, about 35 miles south of Jacksonville, Eocene limestones are reached as indicated by well cuttings at about 211 feet below sea level; while at St. Augustine the Ocala Eocene on the authority of Dr. W. H. Dall is placed at a depth of 224 feet from the surface or about 214 feet below sea level.

In the well of Mr. Oliver Gibbs at Melbourne Beach, Eocene fossils were detected which from the log of the well appear to have come from the depth of 221 feet, the total depth of the well being 318 feet. At the intermediate points between Melbourne and St. Augustine on and near the coast the Eocene limestones lie so far as determined at a depth between 100 or somewhat less and 200 feet below sea level. This is true of wells at Cocoa, where Eocene fossils have been taken from a well the total depth of which does not exceed 190 feet; at New Smyrna, where the Eocene appears from well samples to have been reached at a depth of 105 feet from the surface; at Daytona where from well logs it would seem that the Eocene is somewhat shallower than at New Smyrna,

lying apparently at less than 100 feet from the surface. The depth to the Eocene has been determined approximately at a few inland towns in this area. At Sanford fossils of the Ocala formation have been identified by Cushman at the depth of 113 feet. The surface level at the old railway depot at Sanford is given as 20 feet above sea. The surface level at the well is not known but probably does not differ greatly from the level at the depot. The top surface of the Eocene, therefore, is probably somewhat less than 100 feet below sea level. At Orange Mills the limestones, probably Eocene have been reported at a depth of 130 feet, the surface elevation at this place being about 15 feet above sea level. A slightly increased depth to these limestones is suggested by well records at Hastings.

In the well of the Palmetto Phosphate Company in Polk County the top of the Ocala is placed by Cushman at 360 feet. The surface elevation at Ft. Meade is about 130 feet above sea. The elevation at the well being not greatly different from that at Ft. Meade, the actual level of the top surface of the Ocala formation in this well is probably between 200 and 235 feet below sea level.

The following is a description of a few samples received from a deep well drilled in 1915 for the city of New Smyrna. Samples submitted by F. A. Newell, City Clerk.

Record of Samples from City Well of New Smyrna.

Depth from the surface:

- 93 to 105 feet. Greenish, sandy, calcareous and phosphatic rock, some sharks teeth and fragments of shell.
- 105 feet. Sample containing a greenish rock and some fragments of white limestone.
- 105 feet. Pure white granular, porous limestone.
- 181 feet. Light colored granular limestone.
- 265 feet. Limestone, slightly brownish cast.
- 285 to 296 feet. Limestone, mostly light brown in color.
- 290 feet. Limestone, mostly light brown in color,
- 1022 feet. Brown limestone.

Interpretation: The sample representing material from 95 to 105 feet shows that the phosphatic and calcareous materials lying above the limestones extend to a depth of 105 feet, these samples appear to represent the Miocene, chiefly or entirely. From 105 feet to the bottom of the drill hole is limestone which varies in

color and in hardness. The brown limestone at the depth 1,022, of which only one sample was preserved, is not unlike that of other deep wells in peninsular Florida.

That part of the peninsula in which the Eocene formations so far as known lie at a depth of more than 200 feet below the sea level, includes a small area in the northeastern part of the State and the whole of extreme southern Florida as well as a coastal belt west of the Apalachicola River. The depth at which the Eocene is known more or less definitely, is indicated at several localities within this large area, although the data is as yet very limited. There is in particular complete lack of information as indicated by the question marks placed on the map in the southern part of the Lake Region where the older formations may be expected to lie rather close to the surface. The following description of samples from wells within this area has not been heretofore published.

Well samples from the well of the Okeechobee Company, Okeechobee, Florida. Well located on lot 5, block 134, approximately 34 feet above sea, and about 14 feet above the level of Lake Okeechobee; 10-inch pipe rested at 150 feet; 8-inch pipe rested at 307 feet; 6-inch below this level, amount of 6-inch casing not known.

- 0-2 feet, fine gray sand and soil.
- 2-12 feet, fine sand, chocolate colored some of it indurated with organic matter, ordinary hard pan.
- 12-15 feet, gray or slightly brownish indurated sand (not marl).
- 15-38 feet, gray sands.
- 38-41 feet, the sample preserved consists chiefly of black clay containing considerable sand, one fragment of shell, but aside from this no indication of marl.
- 41-56 feet, sandy shell marl, shells much broken.
- 56-62 feet, shell marl, pecten, barnacles, etc., marine shallow water marl.
- 62-65 feet, gray, sandy marl with broken shell similar to No. 6.
- 65-81 feet, coarse clear grain sand and broken shell. *Ostrea*, *turritella*, bryozoa.
- 81-87 feet, sandy marl with broken shell. Pecten.
- 87-94 feet, very sandy olive colored marl.
- 94-139 feet, light gray incoherent sand.
- 139-158 feet, light colored sandy marl with shell fragments. Pecten. Occasional phosphate pebbles, black and shiny.
- 158-175 feet, olive green sand or very sandy marl.
- 175-212 feet, olive green clay with black smooth shiny pebbles, phosphatic.

- 212-240 feet, dark colored very sandy marl or calcareous sands, some broken shells.
- 240-245 feet, olive green very sandy and calcareous clays, or clayey sands.
- 245-276 feet, very sandy dark colored marl with shell fragments.
- 276-300 feet, calcareous and very sandy clay or clayey sand.
- 300-380 feet, dark colored sand, broken rock and shell fragments.
- 380-403 feet, very sandy dark colored marl, sand grains small.
- 403-458 feet, light colored sandy marls, some shell fragments.
- 458-468 feet, dark clay and broken shells.
- 468-500 feet, drab colored clay.
- 510 feet, white limestone rock with fragments of echinoderm spines.
- 608 feet, chiefly sand.
- 615 feet, white limestone with many fossils.
- 775 feet, limestone powdered fine by the drill.

The following is a record of the well of the Florida East Coast Railway Company drilled at Marathon on the Florida Keys in 1918. The well is cased as follows: 10-inch casing resting at 589 feet; 8-inch casing resting at 605 feet; 6-inch casing extended to 1,128 feet.

Depth of sample from surface.

At the surface, coralline limestone, very hard.

- 35-179 feet. Represented by nineteen samples. All hard limestone, mostly finely powdered by the drill.
- 108-274 feet. Two samples. Very fine white sand, containing well rounded small grains of the mineral Ilmenite.
- 305-409 feet. Four samples. Sand, medium coarse, slightly greenish in color, includes small amounts of clay.
- 412-425 feet. Very coarse sand, including some phosphate pebble. Two samples.
- 427-428 feet. Two samples. Coarse siliceous pebbles, including much pebble phosphate.
- 429-471 feet. Four samples. Medium coarse sand, greenish in color.
- 427-480 feet. Two samples. Coarse sand including clay balls.
- 571-584 feet. Medium coarse sand, mostly greenish in color, contains some clay fragments and some phosphate pebble. Seven samples.
- 584-589 feet. Coarse sand with phosphate pebble. Three samples.
- 593 feet. Porous white limestone, fossils preserved as casts.
- 598 feet. Coarse sand including phosphate pebble. The material of this sample probably fell from above as the 10 inch casing had not yet been set.
- 601-1790 feet. Numerous samples. Limestones.

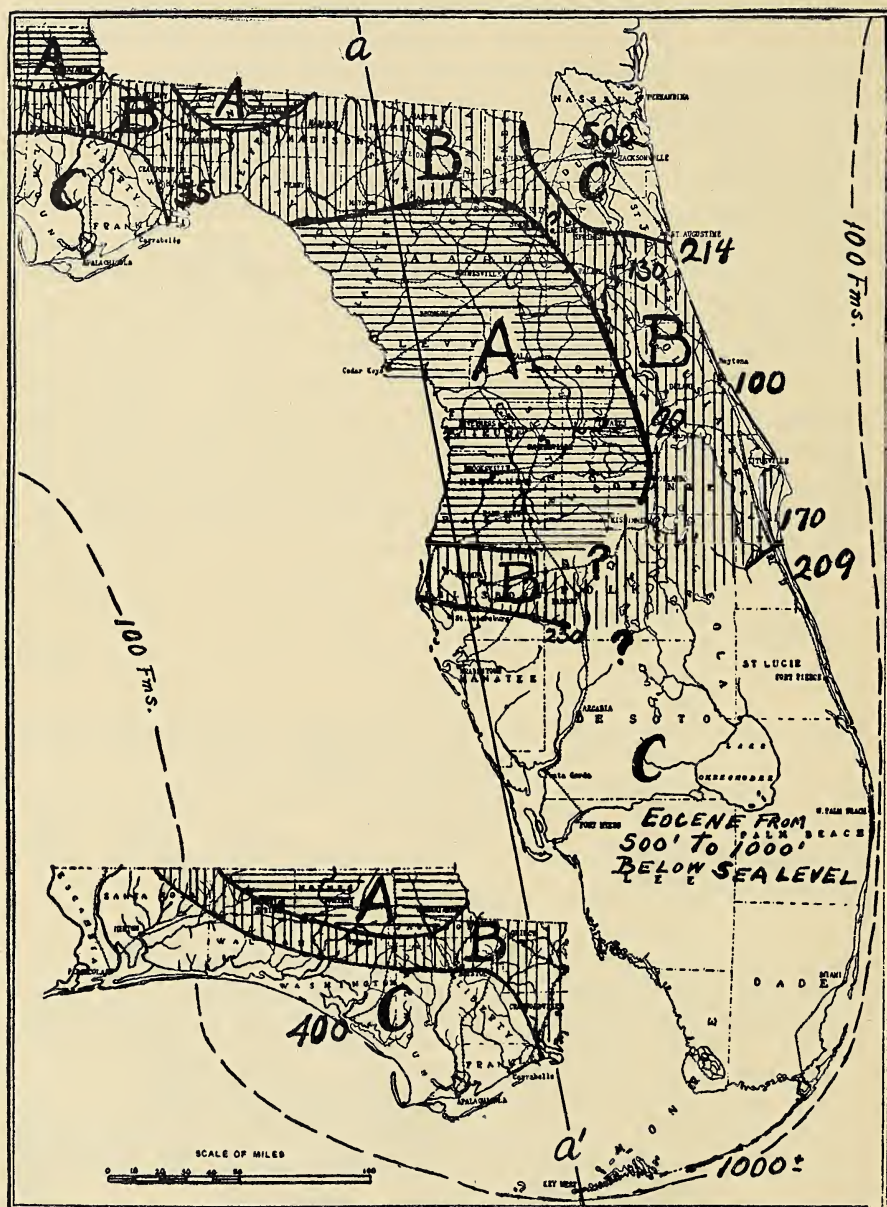


Fig. 3. Sketch map to indicate general structural conditions in Florida. A. Belt of country in which the Eocene formations, when present, lie above sea level, mostly from sea level to as much as about 100 feet above. B. Eocene formations below sea level; for the most part between 0 and 200 feet below. Doubtful territory for both belts A and B is indicated by a question mark. C. Eocene formations probably more than 200 feet below sea level, varying from 200 feet to a maximum, so far as known, of about 1000 feet in the southern part of the peninsula. Figures entered in the map record approximate depth to the top surface of the Eocene, usually the Ocala formation. The margins of the Floridian land mass are approximately coincident with the 100 fathom contour, the location of which is indicated on the map. The axis of the land mass is approximately indicated by the line a-a'.

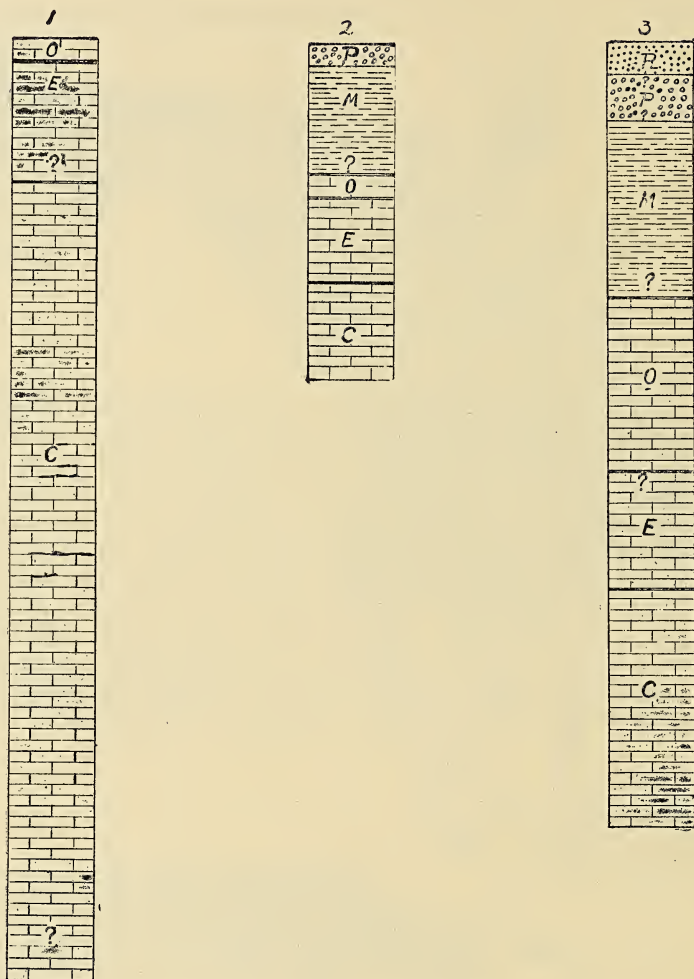


Fig. 4. Thickness of formations indicated by wells. Vertical scale, one inch equals 400 feet. No. 1. Well of Bonheur Development Company, Wakulla County, depth, 2153 feet. No. 2. Well of Palmetto Phosphate Company, Tiger Bay, Polk County, depth, 770 feet. No. 3. Well of Florida East Coast Railway, Marathon, Monroe County, depth, 2300 feet. C, Comanchean; E, Eocene; O, Oligocene; M, Miocene; P, Pliocene; Pl, Pleistocene.

Interpretation: The limestone at the surface is the Key Largo Coraline limestone, Pleistocene. The sands containing phosphate pebble and some clay and extending in this well to a depth of 585 feet are referred to the Miocene. The limestones below 589 feet, according to Cushman, contain foraminifera indicating the Oligocene, and at and below 1,248 feet the Comanchean. The Eocene may be represented, although no identifiable foraminifera were obtained from the Eocene. The Pliocene likewise may be present, although not indicated by fossils.

ASYMMETRY OF THE FLORIDIAN PLATEAU.

The actual position and extent of this plateau, as has been shown by Smith, Vaughan, and others,* is strikingly different to that which appears from the inspection of an ordinary map of the land areas. The 100-fathom contour may be taken as the approximate margin of the plateau, since the slope to this line is for the most part gradual while beyond this contour the slope is rapid, and in places, especially toward the south end of the peninsula, is abrupt. Taking this 100-fathom contour as the margin it will be found that scarcely one-half of the plateau is above water, and that the greater part of that which is above water lies to the east of the north-south axis. With regard to elevation the plateau is therefore asymmetrical, the eastern half being higher, mostly above sea level, than the western half which is almost wholly submerged. This lack of symmetry is apparently due in particular to a tilting or warping of the peninsula toward the west, by which the coast of West Florida has been depressed as far south as Hernando County, while the east coast including all of the southern tip of the peninsula, has been slightly elevated.

*Smith, Eugene A. On the Geology of Florida. Am. Jour. Sci. (3) Vol. 21, pp. 292-309, 1881. *Vaughan, T. Wayland. A Contribution to the Geologic History of the Floridian Plateau, Carnegie Institution Of Washington, Pub. No. 133, 1910.

SUPPLEMENTARY BIBLIOGRAPHY OF FLORIDA GEOLOGY

The following list of papers includes all publications relating to the geology of Florida, of which record has been obtained since the publication of the bibliography contained in the First Annual Report of the Florida Survey, issued in 1908. The list will doubtless be found lacking in completeness and notice of omissions will be appreciated. Aside from papers that have come personally to the attention of the writer the principal sources from which the titles of the publications have been obtained are the successive bibliographies of North American Geology and Paleontology issued by the United States Geological Survey (Bulletins 372, 409, 444, 495, 524, 545, 584, 617, 645, 665, 684).

Baker, Thomas R.

(Red Sands and Other Superficial Materials in the vicinity of Bartow, Florida). *Sci.*, June 16, 1893.

Cope, Edward D.

A Contribution to the Vertebrate Paleontology of Texas. *Amer. Phil. Soc. Proc.* V. 30, pp. 123-131, 1892. (Establishes the genus *Tomolabis* on a specimen from the Caloosahatchee River, Florida).

Cope, Edward D.

On Some Pleistocene Mammalia from Petite Anse, La. *Amer. Phil. Soc. Proc.* V. 34, pp. 458-468, 1896. (Type specimen of *Tomolabis* referred to *Equus fraternus*).

Gannett, Henry.

Description of Quarry Regions. Tenth Census. (Florida Quarry described on pp. 186-187).

Gidley J. W.

Tooth Characters and Revision of the North American Species of the Genus *Equus*. *Amer. Mus. Nat. His.*, V. 14, Art. IX, pp. 91-141, 1901. (Refers to horse teeth on Peace Creek, p. 121).

Hrdlicka, Ales.

Skeletal Remains Suggesting or Attributed to Early Man In North America. Bureau of Amer. Ethnology, Bul. 33,

LeBaron, J. Francis.

Discussion following paper by Walter B. M. Davidson on The Geological Origin of Phosphate of Lime in the United States and Canada. *Amer. Inst. Min. Eng.* Baltimore meeting, Feb, 1892, published 1893.

Lucas, F. A.

The Fossil Bisons of North America. U. S. Nat. Mus. Proc. pp. 755-771, 1899. (Bison latifrons referred to as being found on East Creek Florida).

Pickell, J. M.

Florida Phosphate. Fla. Agri. Exp. Station, Bull. 10, pp. 6-11, July, 1890.

Roberts, William.

An account of the First Discovery and Natural History, of Florida, with a particular detail of the several expeditions and descents made on that coast. Collected from the best authorities by William Roberts. Illustrated by a general map, and some particular plans together with a geographical description of that country, By T. Jefferys, Geographer to His Majesty, London; Printed for T. Jefferys at Charing Cross, MDCCLXIII.

Romans, Bernard

Natural History of East and West Florida, 1775.

Vaughan, T. Wayland.

(Notes on the Geology and Age of Human Remains near Osprey, Florida). Bureau of Amer. Ethnology, Bull. 33, 64-66, 1907.

Vignoles, Charles.

Observations upon the Floridas. 190 pp. and map. New York, 1823.

Walker, Samuel T.

On the Origin of the Fossil Bones, Discovered in the Vicinity of Tises Ford, Florida. U. S. Nat. Proc. V. 6, pp. 427-429, 1884. (Extract from a letter to Prof. Baird, relating to fossils on Peace Creek, Florida).

Williams, John Lee.

A view of West Florida, embracing its geography, topography, etc., with an appendix, treating of its antiquities, land titles, and canals, and containing a map, exhibiting a chart of the coast, a plan of Pensacola, and the entrance of the harbour. 178 pp., and folded colored map. Philadelphia, 1827.

Williams, John Lee.

The territory of Florida: or sketches of the topography, civil and natural history of the country, the climate, and the Indian tribes, from the first discovery to the present time, with a map, views, etc. 304 pp. A. T. Goodrich, New York, 1837.

Willis, Bailey.

(Formations of limestones in the Everglades, Florida). Jour. of Geol. V. 1, pp. 512-514, 1893.

BIBLIOGRAPHY OF FLORIDA GEOLOGY, 1908 TO 1918.

Aldrich, T. H.

A new fossil *Mitra* from west Florida, and a new Eocene *Astarte*. Nautilus, vol. 23, No. 10, pp. 121-122, 1 pl. March, 1910.

Berry, Edward Wilber.

The physical conditions and age indicated by the flora of the Alum Bluff formation: U. S. Geol. Survey, Prof. Paper 98, pp. 41-59, 4 pls., 1 fig., May 27, 1916. Abstract, Washington Acad. Sci., Jour., Vol. 6, No. 14, p. 505, August 19, 1916.

The Fossil Plants from Vero., Florida. Journal of Geology, Vol. 25, pp. 661-666, October-November, 1917.

Blair, A. W.

Ground Phosphate Rock as a source of Phosphoric Acid. Fla. Agri. Exp. Station. Press Bull. No. 77, 1908.

Brown, Lucius P.

The Phosphate Deposits of Continental North America. Eighth International Congress of Applied Chemistry. Vol. XXVI, pp. 87-113, 1912. The Florida phosphates are discussed on pages 95-101.

Chamberlain, Rollin T.

Interpretation of the Formations Containing Human Bones at Vero, Florida, Journal of Geology, Vol. 25, pp. 25-39, January-February, 1917.

Further Studies at Vero, Florida. Journal of Geology, Vol. 25, pp. 667-683, October-November, 1917.

Clapp, Frederick G.

The Grand Gulf and Lafayette formations in northern Florida. Abstract: Science, new ser., Vol. 27, p. 993, June 26, 1908.

Collison, S. E.

The Phosphate Deposits of the United States. The Florida Pennant, Agricultural Number, pp. 37-39, 1911.

Cooke, Charles Wythe.

The age of the Ocala Limestone: U. S. Geol. Survey Prof. Paper 95, pp. 107-117, 1915.

The age of the Ocala limestone of Florida (abstract): Washington Acad. Sci., Jour., Vol. 6, No. 1, p. 22, January 4, 1916.

Dall, William Healey.

A monograph of the molluscan fauna of the Orthaulax pugnax zone of the Oligocene of Tampa, Florida: U. S. Nat. Mus., Bull. 90, 173 pp., 26 pls., 1915.

Dickerson, Roy E.

Ancient Panama Canals. Proc. Calif. Acad. Sci., Vol. 7, No. 8, p. 201, 1917.

Florida Geological Survey.

Map of Florida showing topography, hard rock and land pebble phosphate deposits, and areas of artesian flow, 1913. Scale, 1 inch equals 32 miles (about).

Forsyth, Carl C.

A report on some allochthonous peat deposits of Florida: *Bot Gazette*, Vol. 62, No. 1, pp. 32-52, July, 1916.

Gunter, Herman (with Sellards, E. H.)

The fuller's earth deposits of Gadsden County, Florida. With notes on similar deposits found elsewhere in the State. *Florida State Geol. Survey*, 2nd. Ann. Rept., pp. 253-291, 4 pls., 2 figs., 1909.

The artesian water supply of eastern Florida: *Florida State Geol. Survey*, 3rd Ann. Rept., pp. 77-195, 16 figs., 1910.

The underground water supply of west central and west Florida. *Florida State Geol. Survey*, 4th Ann. Rept. pp. 81-155, 4 pls., 12 figs., 1912.

Artesian water supply of eastern and southern Florida: *Florida State Geol. Survey*, 5th Ann. Rept., pp. 103-290, 5 pls., 17 figs., 1 map (in pocket), 1913.

Hall, Archibald A.

Analysis of a Florida clay: *Durham, Univ. Philos. Soc.*, Vol. 4, pp. 228-229, 1912.

Harper, Roland M.

Preliminary report on the peat deposits of Florida. *Florida State Geol. Survey*, 3rd Ann. Rept., pp. 197-375, 13 pls., 14 figs., 1910.

Chondrophora virgata in West Florida. *Torrey* 11:98, fig. 1. April, 1911.

Early spring aspects of the coastal plain vegetation of South Carolina, Georgia, and northeastern Florida. *Bull. Torrey Bot. Club* 38:223-236. "May" (June), 1911.

A quest for the Wakulla volcano. *Florida Review* 6:215-224, with 3 half-tones. Sept., 1911.

The river-bank vegetation of the lower Apalachicola, and a new principal illustrated thereby. *Torrey* 11:225-234, fig. 1. Nov., 1911.

Notes on the Distribution of the southeastern salamanders (*Geomys Tuza* and allies). *Science* 11:35:115-119, Jan. 19, 1912.

The coniferous forests of eastern North America. *Pop. Sci. Monthly* 85:338-361, with 16 half-tones not numbered. Oct., 1914.

(Topography, streams and springs, lakes and ponds, coast and harbors, climate, vegetation flora, fauna and forest products of Florida.) *New International Encyclopaedia*, Second Edition, 7:706-709, 713. Dodd, Mead & Co., New York, Dec. 1914.

Harshberger, John W.

The vegetation of South Florida, south of 27 30' north, exclusive of the Florida Keys. *Trans. Wagner Free Inst. Sci. (Philadelphia)* 7: 49-189, with map, 2 text-figures and 10 plates. Dec. 1914.

Hay, Oliver P.

The fossil turtles of North America. *Carnegie Inst., Publication No. 75*, 1908.

Notes on some fossil horses, with descriptions of four new species. U. S. Nat. Mus. Proc., Vol. 44, pp. 569-594, pls. 69-73, 1913.

The Quaternary Deposits at Vero, Florida, and the Vertebrate Remains Contained Therein. Journal of Geology, Vol. 25, pp. 52-55, January-February, 1917.

On the Finding of Supposed Pleistocene Human Remains at Vero, Florida. Journal Washington Academy of Sciences, Vol. 7, pp. 258-260, June 4, 1917.

A Review of some papers on fossil man at Vero, Florida. Science, new ser., Vol. 47, No. 1215, pp. 370-371, April 12, 1918.

Doctor Ales Hrdlicka and the Vero man. Science, new ser., Vol. 48, No. 1245, pp. 459-462, Nov., 8, 1918.

Holmes, W. H.

On the antiquity of man in America. Science, new ser., Vol. 47, No. 1223, pp. 561-562, June 7, 1918.

Hrdlicka, Alex.

Preliminary Report on Finds of Supposedly Human Remains at Vero, Florida. Journal of Geology, Vol. 25, pp. 43-51, January-February, 1917.

Recent Discoveries Attributed to Early Man in America. Bureau of American Ethnology, Bull. 66, Washington, 1918.

Mayer, A. G.

Our neglected southern coast. Nat. Geog. Mag. 19:589-871. Dec., 1909.

MacCurdy, George Grant.

Archaeological Evidence of Man's Antiquity at Vero, Florida. Journal of Geology, Vol. 25, pp. 56-62, January-February, 1917.

The Problems of Man's Antiquity at Vero, Fla., Amer. Anthropologist, n. s. pp. 252-261, Vol. 19, No. 2, April-June, 1917.

Mansfield, Wendell C.

Mollusks from the type locality of the Choctawhatchee marl: U. S. Nat. Mus., Proc., Vol. 51, pp. 599-607, 1 pl., December 21, 1916.

Matson, George Charlton.

Notes on the clays of Florida. U. S. Geol. Survey, Bull. 380, pp. 346-357, 1909.

Report on examination of material from the sea bottom between Miami and Key West, Florida. Carnegie Inst. Washington, Publ. No. 133 Papers from the Tortugas Laboratory, Vol. 4, pp. 120-125, 1910.

The phosphate deposits of Florida: U. S. Geol. Survey, Bull. 604, 101 pp. 17 pls. (incl. maps), 2 figs., 1915. Abstract (by W. C. Phalen), Washington Acad. Sci., Jour., Vol. 5, No. 20, p. 648, December 4, 1915.

The Pliocene Citronelle formation of the Gulf Coastal Plain: U. S. Geol. Survey, Prof. Paper 98, pp. 167-192, 12 pls., 3 figs., September 11, 1916. Abstract, Washington Acad. Sci., Jour., Vol. 6, No. 19, p. 663, November 19, 1916.

Matson, George Charlton, and Clapp, Frederick G.

A preliminary report on the geology of Florida with special reference

to the stratigraphy.—Florida State Geol. Survey, 2d. Ann. Rept., pp. 25-173, 8 pls., 2 figs., 1 map, 1909.

Matson, George Charlton, and Sanford, Samuel.

Geology and ground waters of Florida: U. S. Geol. Survey, Water-Supply Paper 319, 445 pp., 17 pls. (inclu map, in pocket), 7 figs., 1913.

Maury, Carlotta Joaquina.

New Oligocene shells from Florida. Bull. Am. Paleont., No. 21, Ithaca, New York, pp. 119-164, 9 pls., March 1, 1910.

Santo Domingo Type Sections and Fossils, Bulletins Amer. Paleontology. Vol. 5, No. 30. Correlation table. 1917.

McAtee, W. L.

A list of plants collected on St. Vincent Island, (Franklin Co.) Florida. Proc. Biol. Soc. Washington, 6:39-52. March, 1913.

Mendenhall, H. D.

Modern Land-Pebble Phosphate-Mining Plants in Florida. Engr. News, Vol. 60, No. 16, pp. 410-414, October 15, 1908.

Merrill, George Perkins.

A newly found meteoric stone from Lake Okeechobee, Florida: U. S. Nat. Mus., Proc., Vol. 51, pp. 525-526, December 21, 1916.

Nelson, N. C.

Review of the Ninth Annual Report of the Florida Geological Survey. Science, new ser., Vol. 47, No. 1216, pp. 394-395, April 19, 1918.

Chronology in Florida. Anthropological Papers of the American Museum of Natural History, Vol. 22, pt. 2, 7 figs., New York, 1918.

Olsson, Axel.

New and interesting Neocene fossils from the Atlantic Coastal Plain: Bull. Am. Paleont., 24, pp., December 7, 1914.

Osborn, H. F.

Cenezoic mammal horizons of western North America, with faunal lists of the Tertiary Mammalia of the West by William Diller Mathew, U. S. Geol. Survey, Bull. 361, 138 pp., pls. 3, 15 figs., 1909.

The Age of Mammals in Europe, Asia and North America, 635 pp. New York, 1910. The MacMillan Company.

Sanford, Samuel.

The topography and geology of southern Florida.—Florida State Geol. Survey, 2d. Ann. Rept., pp. 175-231, 2 pls., 1 fig., 1909. Mineral resources of the United States, 1908: Mineral waters, pp. 755-790.

Scott, W. B.

A History of Land Mammals in the Western Hemisphere, 693 pp. New York, 1913. The MacMillan Company.

Sellards, E. H.

First annual report of the Florida State Geological Survey, 1907-08, 114 pp., 6 pls., 1908.

A preliminary report on the underground water supply of central Florida.—Florida State Geol. Survey, Bull. No. 1, 103 pp., 6 pls., 6 figs., 1908.

Mineral industries (of Florida). Florida State Geol. Survey, 2d. Ann. Rept., pp. 233-251, 5 pls., 1909.

A preliminary paper on the Florida phosphate deposits. Florida State Geol. Survey, 3rd Ann. Rept., pp. 17-41, 5 pls., 1910.

Some Florida lakes and lake basins. Florida Geol. Survey, 3rd Ann. Rept., pp. 43-76, 4 pls, 5 figs., 1910.

The Florida phosphate deposits. *Am. Fertilizer*, Vol. 35, No. 10, pp 37-47, 13 figs., November 4, 1911.

An intermittent spouting well. *Science*, new ser., Vol. 33, pp. 37-38, January 6, 1911.

The soils and other surface residual materials of Florida, their origin, character, and the formations from which derived: a study in agrogeology: Florida State Geol. Survey Fourth Ann. Rept., pp. 1-79, 12 pls., 1 map, 3 figs., 1912.

Production of phosphate rock in Florida during 1910: Florida State Geol. Survey, Fourth Ann. Rept., pp. 157-168, 1912.

Classification of the soils of Florida: Florida, Dept Agr., 12th Bienn. Rept., pp. 249-300, 1913.

Origin of the hard rock phosphates of Florida: Florida State Geol. Survey, Fifth Ann. Rept., pp. 23-80, 9 pls., 1 map, 1913.

Origin of the hard rock phosphate deposits of Florida (abstract): *Geol. Soc. America*, Bull., Vol. 24, No. 4, pp. 716-717, December 23, 1913.

The relation between the Dunnellon formation and the Alachua clays of Florida: Florida State Geol. Survey, Sixth Ann. Rept., pp. 161-162, 1914.

The origin, mining, and preparation of phosphate rock: *Am. Inst., Min. Eng. Bull.* No. 93, pp. 2379-2395, 3 figs., September, 1914.

The development of some lake beds in Florida (abstract): *Science*, new ser., Vol. 39, p. 404, March 13, 1914.

Mineral industries and resources of Florida: Florida State Geol. Survey, Sixth Ann. Rept., pp. 21-114, map, 20 figs., 1914.

Some Florida lakes and lake basins: Florida State Geol. Survey, Sixth Ann. Rept., pp. 115-159, 13 figs., 1914.

Seventh annual report: Florida Geol. Survey, 342 pp. 80 figs., 4 maps, Tallahassee, 1915.

The pebble phosphates of Florida: Florida Geol. Survey, Seventh Ann. Report, pp. 21-116, 1915.

Natural resources survey of an area in central Florida; geology and mineral resources: Florida Geol. Survey, Seventh Ann. Rept., pp. 121-133, 1915.

A new gaval from the late Tertiary of Florida (*Tomistoma americana*) *Am. Jour. Sci.*, 4th ser., Vol. 40, pp. 135-145, 6 figs., August, 1915.

Chlamytherium septentrionalis, an edentate from the Pleistocene of Florida: *Am. Jour. Sci.*, 4th ser., Vol. 40, pp. 139-145, 6 figs. August, 1915.

Stratigraphic relations of the fossil vertebrate localities of Florida (abstract): *Geol. Soc. America, Bull.* Vol. 26, No. 1, p. 154, March 31, 5-18 1916.

Mineral industries of Florida during 1915: *Florida State Geol. Survey* 8th Ann. Rept., pp. 19-37, 1916.

Fossil vertebrates from Florida; a new Miocene fauna; new Pliocene species; the Pleistocene fauna: *Florida State Geol. Survey*, 8th Ann. Rept., pp. 77-119, 5 pls., 1916.

Human Remains and associated fossils from the Pleistocene of Florida: *Florida State Geol. Survey*, 8th Ann. Rept., pp. 121-160, 17 pls., 15 figs., 1916.

On the discovery of fossil human remains in Florida in association with extinct vertebrates: *Am. Jour. Sci.*, 4th Ser., Vol. 42, pp. 1-18, 12 figs., July, 1916.

A new tortoise and a supplementary note on the gavial, *Tomistoma americana* (from Florida): *Am. Jour. Sci.*, 4th ser., Vol. 42, pp. 235-240, 2 figs., September, 1916.

Human remains from the Pleistocene of Florida: *Science*, new ser., Vol. 44, pp. 615-617, 1 fig., October, 27, 1916.

Dead Lake of the Chipola River, Florida (abstract): *Geol. Soc. America, Bull.*, Vol. 27, No. 1, p. 109, March 30, 1916.

On the Association of Human Remains and Extinct Vertebrates at Vero, Florida. *Journal of Geology*, Vol. 25, pp. 4-24, January-February, 1917.

Further Notes on Human Remains from Vero, Florida *Amer. Anthropologist*, N. S. pp. 239-251, Vol. 19, No. 2, April-June, 1917.

Note on the Deposits Containing Human Remains and Artifacts at Vero, Florida, *Journal of Geology*, Vol. 25, pp. 659-660, October-November, 1917.

Sellards, E. H. and Gunter, Herman.

The fuller's earth deposits of Gadsden County, Florida. With notes on similar deposits found elsewhere in the State. *Florida State Geol. Survey*, 2d. Ann. Rept., pp. 253-291, 4 pls., 2 figs., 1909.

The artesian water supply of eastern Florida. *Florida State Geol. Survey*, 3rd Ann. Rept., pp. 77-195, 16 figs., 1910.

The underground water supply of west central and west Florida: *Florida State Geol. Survey*, Fourth Ann. Rept., pp. 81-155, 4 pls., 12 figs., 1912.

Artesian water supply of eastern and southern Florida: *Florida State Geol. Survey*, Fifth Ann. Rept., pp. 103-290, 17 figs., 5 pls., 1 map (in pocket), 1913.

Sellards, E. H., Gunter, H., and Cox, N. H.

Roads and road materials of Florida: *Florida State Geol. Survey, Bull.* No. 2, 31 pp., 4 pls., May, 1911.

Sheldon, Pearl G.

The Atlantic slope Aræas: *Paleontographica Americana*, Vol. 1, No. 1, 103 pp., 16 pl. (maps and illus.) 9 figs., 1916.

Smith, J. D. (of Marianna).

About unknown Florida. Fla. Review 2:33-39 (including 3 full-page half-tones). July, 1909.

Stone, C. A.

Milling and mining Florida phosphates. Eng. and Min. Jour., Vol. 87, pp. 490-492, 11 figs., March 6, 1909.

Sutherland, W. J.

Physiography of the Gulf Coastal plains.—Jour. Geog., Vol. 6, No. 11, pp. 337-347, June 1908.

Van Horn, F. B.

The phosphate deposits of the United States., U. S. Geol. Survey, Bull. 394, pp. 157-171, 1909. Rept. Nat. Conservation Comm. (60th Cong., 2nd. sess., Sen. Doc. No. 676), Vol. 3, pp. 558-570, 1909. Abstract: Min. and Sci. Press, Vol. 99, pp. 88-90, 2 figs., July 17, 1909.

Mineral Resources of the United States, 1908: Phosphate rock, pp. 629-642.

Vaughan, Thomas Wayland.

Geology of the Keys, the marine deposits, and recent corals of southern Florida.—Carnegie Inst. Washington, Year Book No. 8, 1909, pp. 140-144, 1910. 7. 1908, pp. 131-136, 1909.

The geologic work of mangroves in southern Florida.—Smithsonian Misc. Coll., Vol. 52 (Quart. Issue, Vol. 5, pt. 4), pp. 461-464, 7 pls., 2 figs., 1909.

Geology of the Keys, the marine bottom deposits, and recent corals of southern Florida.—Carnegie Inst. Washington, Year Book No. 8, 1909, pp. 140-144, 1910.

Sketch of the geologic history of the Floridian Plateau. Science, new ser., Vol. 32, pp. 24-27, abstract, p. 32, July 1, 1910.

A contribution to the geologic history of the Floridian Plateau. Carnegie Inst. Washington, Publ. No. 133, Papers from the Tortugas Laboratory, Vol. 4, pp. 99-185, 15 pls., 6 figs., 1910.

The keys, corals, and coral reefs of Florida. Abstract: Science, new ser., Vol. 33, pp. 751-752, May 12, 1911.

Studies of the geology and of the Madreporaria of the Bahamas and of southern Florida: Carnegie Inst. Washington, Yearbook No. 11, 1912, pp. 153-162, (1913).

Remarks on the geology of the Bahama Islands, and on the formation of the Floridan and Bahamas oolites (abstract): Washington Acad. Sci., Jour., Vol. 3, No. 10, pp. 302-304, May 19, 1913.

Investigations of the geology and geologic processes of the reef tracts and adjacent areas in the Bahamas and Florida: Carnegie Inst. Washington, Yearbook No. 12, pp. 183-184, 1913.

Sketch of the geologic history of the Florida coral reef tract and comparisons with other coral reef areas: Washington Acad. Sci. Jour., Vol. 4, No. 2, pp. 26-34, January 19, 1914.

Geologic history of the Florida coral reef tract and comparisons with other coral reef areas (abstract): Geol. Soc. America, Bull., Vol. 25, No. 1, pp. 41-42, March 30, 1914.

The building of the Marquesas and Tortugas atolls and a sketch of the geologic history of the Florida reef tract: Carnegie Inst. Washington, pub. No. 182 (Papers from the Tortugas Laboratory, Vol. 5), pp. 55-67, 1914.

Coral reefs and reed corals of the southeastern United States; their geologic history and significance (abstract and discussion:) Geol. Soc. America, Bull., Vol. 26, No. 1, pp. 58-60, March 31, 1915; Abstract, Science, new ser., Vol. 41, pp. 508-509, April 2, 1915.

On Reported Pleistocene Human Remains at Vero, Florida. Journal of Geology, Vol. 25, pp. 40-42, January-February, 1917.

Vaughan, Thomas Wayland, and Shaw, Eugene Wesley.

Geologic investigations of the Florida coral reef tract: Carnegie Inst. Washington, Year Book No. 14, 1915, pp. 232-238, 1 fig., 1916.

Vaughan, T. W., and Cooke, C. W.

Correlation of the Hawthorn formation: Washington Acad. Sci., Jour., Vol. 4, No. 10, pp. 250-253, May 19, 1914.

Waggaman, William H.

A review of the phosphate fields of Florida. U. S. Dept. Agric., Bur. Soils, Bull. No. 76, 23 pp., 1911.

Wieland, G. R.

The Vero Man and the Sabre Tooth. Science, new ser. Vol. 48, No. 1230, pp. 93-94, July 26, 1918.

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